GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

PAGE NO. M-1
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 1-1

MOCK-UP DESIGNATION M-1 DATE 9-16-63

SUBMITTED BY P. R. Knaff REPRESENTING Bellcomm

DISCUSSED WITH H. Sherman (Contractor Rep) J. Shows (FCOD MSC) (NASA Rep)

ITEM l.h. Window

INQUIRY

In configuration F, the window is angled such that with either astronaut facing forward with head in the "normal" position, a reflection of the illuminated instruments will be seen. The extent to which this would interfere with normal operations cannot now be stated, but it is reasonable to assume that it would interfere with visually based operations, especially on the earthlit side of the moon.

REMARKS AND RECOMMENDATION

It is recommended that this problem be studied to assess the magnitude of the nterference noted above. As a result of the study, a recommendation for circumventing r overcoming this problem should be generated.

It is further recommended that this be made a portion of an overall investigation of interior lighting in the LEM.

BOARD ACTION

GAEC to review proposed plan for LEM interior lighting at the October Crew Systems Meeting. This plan will involve updating of the M-1 Mock-up for use in the lighting study.

DE	OPR	#	T	PGM	SUBJ	SIGNATURE
09-18-63	GAC	LEM-R-63-1	R	LM	L CHIT. Nos. 1-1-6-3	GAC LOG 063-64

CLASS I ☒ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☒

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
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PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 1-2

MOCK-UP DESIGNATION M-1 DATE 9-16-63

SUBMITTED BY J P. Loftus REPRESENTING MSC

DISCUSSED WITH H. Sherman (Contractor Rep) Paul R. Penrod (NASA Rep)

ITEM 1.k. Cockpit Geometry No. 1

INQUIRY

What effect will luminosity of the RCS engine plumes and thrusters have on crew vision and visibility?

REMARKS AND RECOMMENDATION

Problems to be considered are brightness effects on dark adaptation and coating effects of residue on window.

BOARD ACTION

MSC will insure the acquisition of data, to support this study, during the SM RCS altitude testing at AEDC.

GAEC to pursue the analytical effort related to glowing of thrusters, geometry of plume, etc.

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CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☒ YES ☐

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
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DATE 9-18-63
CHIT NO. 1-3

MOCK-UP DESIGNATION M-1 DATE 9-16-63

SUBMITTED BY Hays / Correale REPRESENTING CSD/MSC

DISCUSSED WITH R. Stone (Contractor Rep) Paul R. Penrod (NASA Rep)

ITEM Cockpit Geometry No. 1 m

INQUIRY

Egress should be through top hatch.

REMARKS AND RECOMMENDATION

Front egress is a blind operation. Front tunnel and Platform may be hot and since the astronaut will be either on knees, side or rear end, the insulation in the coverall will be compressed and reduced in effectiveness. This requirement for good insulation under a load should be avoided. The boot will be designed to permit this. Front hatch should be used for docking and emergency ingress.

BOARD ACTION

GAEC to continue study of trade-offs involved in use of either hatch for lunar egress. Purpose of this study is to determine prime means of egress and to determine extent of provisions for secondary means of egress. MSC to investigate thermal compression ~~design of suit.~~ effects on the suit due to

CLASS I ☐ - GAEC IS DIRECTED TO COMPLY
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CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☒ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☐

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
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PAGE NO.
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DATE 9-18-63
CHIT NO. 1-4

MOCK-UP DESIGNATION M-1 DATE 9-16-63

SUBMITTED BY Hays / Correale REPRESENTING CSD - MSC

DISCUSSED WITH J. M. Rigsby (Contractor Rep) Paul R. Penrod (NASA Rep)

ITEM Cockpit Geometry No. 1 c

INQUIRY

Floor should be changed at AOT Station.

REMARKS AND RECOMMENDATION

Present floor level requires that operator straddle hatch recess while using AOT. (Shown in Film). If hatch stiffening ribs were designed considering this, the floor level should be raised thereby not requiring this straddle. In getting into this position, there may be accidental control operation on front display and control console.

BOARD ACTION

Refer to Chit No. 6-3.

CLASS I ☐ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☒ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☐

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
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PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 1-5

MOCK-UP DESIGNATION M-1 DATE 9-17-63

SUBMITTED BY J. Chamberlin REPRESENTING NASA MSC

DISCUSSED WITH W. W. Peterson (Contractor Rep) C. E. Sisler (NASA Rep)

ITEM Cockpit Geometry
INQUIRY

REMARKS AND RECOMMENDATION

There is a good possibility that soft suits will not meet meteorite and ejecta reliability criteria. The cockpit geometry, and egress and ingress features should be made suitable for a hard (Armored) suit (which is under development as a backup).

BOARD ACTION

GAEC to continue to use present APOLLO suit design criteria. MSC will assess the affect of current meteroid and ejecta data being used in the Apollo Program on the design of the current suit.

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CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☐

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
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~~REPORT NO.~~ LEM-R-63-1
~~DATE~~ ~~9-18-63~~
CHIT NO. 1-6

MOCK-UP DESIGNATION M-1 DATE 9-17-63

SUBMITTED BY W. North REPRESENTING NASA MSC

DISCUSSED WITH Kelly (Contractor Rep) Franklin (NASA Rep)

ITEM Windows

INQUIRY

Consider design feasibility of small window above each pilot's head. This would enable direct pitch, yaw, and especially pilot roll horizon reference during final stages of lunar ascent in event of attitude display failure.

REMARKS AND RECOMMENDATION

BOARD ACTION

Refer to Chit No. 6-1.

CLASS I ☐ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☒ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☐

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
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PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 1-7

MOCK-UP DESIGNATION ~~M-1~~ DATE ~~9-17-63~~

SUBMITTED BY ~~D. K. Slayton~~ REPRESENTING ~~NASA MSC~~

DISCUSSED WITH R. C[illegible] (Contractor Rep) W. F. R[illegible] (NASA Rep)

ITEM

INQUIRY

REMARKS AND RECOMMENDATION

Film showed special tool for operating hatches. This is undesireable. Hatches should have simple integrated latching and locking mechanism.

BOARD ACTION

~~GAEC is directed to comply with the recommendation that the~~ LEM hatches ~~should~~ shall have simple integrated latching and locking mechanisms.

CLASS I [X] - GAEC IS DIRECTED TO COMPLY
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CLASS IV [ ] - RETAIN AS DESIRABLE OBJECTIVE
CLASS V [ ] - DISAPPROVED
CLASS VI [ ] - REFERRED

CHANGE MOCK-UP NO [X] YES [ ]

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
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REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 1-8

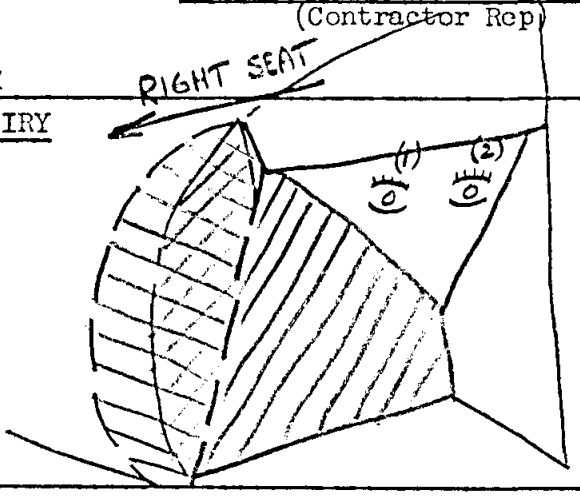
MOCK-UP DESIGNATION Cockpit Study Configuration F DATE 9-18-63

SUBMITTED BY J. W. Young REPRESENTING MSC AAO

DISCUSSED WITH Bob Smyth (Contractor Rep) A. B. Sheppard, Jr. (NASA Rep)

ITEM

INQUIRY



It appears that black plane area (viewed from outside looking in) is designed for the normal eye position (1). The helmeted eye can be moved forward significantly (2), This forward position increases rear and outside visibility which then becomes restricted by the plane.

REMARKS AND RECOMMENDATION

It is recommended to further increase, visibility sideways and rearward GAEC consider chopping the plane back as much as feasible for a forward eye position (see dotted lines, for example.)

BOARD ACTION

It is recommended that to further increase visibility, GAEC consider modifying the external structure of the front face to provide maximum view from a forward eye position.

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CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☒

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
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CHIT NO. 1-9

MOCK-UP DESIGNATION M-1 DATE 9-17-63

SUBMITTED BY W. North REPRESENTING NASA MSC

DISCUSSED WITH Kelly (Contractor Rep) Franklin (NASA Rep)

ITEM

INQUIRY

Consider design feasibility of small window above each pilot's head to provide view of command module during normal separation or emergency docking with top hatch.

REMARKS AND RECOMMENDATION

BOARD ACTION

There is no ~~need~~ requirement for viewing the Command Module from LEM during normal separation ~~(after the transposition dock)~~. The LEM may be maneuvered to view the Command Module immediately after separation if desired. Present design approach for the LEM assumes that if the LEM forward hatch is disabled after rendezvous the Command Module will actively dock on the LEM top hatch. Reference MSC Document S-DC-304A "Docking Ground Rules and Design Criteria - Extendable Probe Concept" (9-63).

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CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☒ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☒ YES ☐

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
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DATE 9-18-63
CHIT NO. 2-1

MOCK-UP DESIGNATION M-1 DATE 9-16-63

SUBMITTED BY Hays / Correale REPRESENTING CSD/MSC

DISCUSSED WITH J. M. Rigsby (Contractor Rep) Paul R. Penrod (NASA Rep)

ITEM Seats (2) and (3)

INQUIRY

PLSS stowage should be included in seat.

REMARKS AND RECOMMENDATION

Storage on seat would avoid the confusion and general complication of donning, doffing and stowing PLSS. In addition, when returned from Lunar surface and if LEM repressurization is not possible, the astronaut would have to remove and stow PLSS while under pressure. The seat stowage will assure unassisted donning and doffing.

BOARD ACTION

Refer to Chit No. 3-5.

CLASS I ☐ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☒ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☐

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CHIT NO. 3-1

MOCK-UP DESIGNATION M-1 DATE 9-16-63

SUBMITTED BY J. P. Loftus REPRESENTING MSC

DISCUSSED WITH W. Peterson (Contractor Rep) Paul R. Penrod (NASA Rep)

ITEM Seat, Cage System and Restraint No. 3a

INQUIRY

REMARKS AND RECOMMENDATION

The cage concept seems promising but would profit from:

1. Remove bar restriction to set movement of arm
2. Provide rigid seat surface to avoid compression loads on pelvis
3. Set pivots in a track to allow movement against exterior wall to provide max clear area in cabin

BOARD ACTION

Refer to Chit No. 3-5.

CLASS I ☐ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☒ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☐

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
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REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 3-2

MOCK-UP DESIGNATION M-1 DATE

SUBMITTED BY L. D. Paige REPRESENTING OMSF/MSA

DISCUSSED WITH J. M. Rigsby (Contractor Rep) Paul R. Penrod (NASA Rep)

ITEM Body Restraint No. 2 - 3

INQUIRY

Study alternative means of body restraint utilizing fabric materials which can be individually tailored and pre-suspended for each astronaut.

REMARKS AND RECOMMENDATION

Presently proposed hardware solutions to the suspension problem involve some loss in the flexibility and mobility which were apparent virtues of the "stand-up" concept. A garment-type restraint could be strong, lightweight, flexible, comfortable, and adequately protective against adverse accelerations. A "BVD" type of garment, or perhaps a long-waisted vest, which can be "backed" into and secured with a simple, one-motion fastener, might be feasible.

BOARD ACTION

Refer to Chit No. 3-5.

CLASS I ☐ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☒ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☐

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DATE 9-18-63
CHIT NO. 3-3

MOCK-UP DESIGNATION ~~M-1~~ DATE 9-17-63

SUBMITTED BY ~~Paul Penrod~~ REPRESENTING MSC ASPO

DISCUSSED WITH ~~H. Sherman~~ (Contractor Rep) Paul R. Penrod (NASA Rep)

ITEM ~~N 3~~

INQUIRY

Present cage does not permit standing on floor at crew station.

REMARKS AND RECOMMENDATION

~~Would improve~~ crew mobility and efficiency at the stations is improved if capability ~~if possibility of~~ anding, independent of cage is provided.

BOARD ACTION

Refer to Chits No. 3-5 and 6-3.

CLASS I ☐ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☒ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☐

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MOCK-UP DESIGNATION M-1 DATE 9-17-63

SUBMITTED BY Paul R. Penrod REPRESENTING MSC-ASPO

DISCUSSED WITH H. Sherman (Contractor Rep) Paul. R. Penrod (NASA Rep)

ITEM Seat, Cage No. 3

INQUIRY

"Survivable Crash Loads" is a controlling influence on support and restraint design. The conceptual hardware indicates a relatively high expectation.

REMARKS AND RECOMMENDATION

Only crash loads which are attendant to a condition from which Lunar launch could be accomplished need be considered. (i.e. Toppling loads). The loads envelope needs to be accurately established.

BOARD ACTION

Refer to Chit No. 3-5.

CLASS I ☐ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
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CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☒ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☐

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MOCK-UP DESIGNATION LEM M-1 DATE 9-17-63

SUBMITTED BY Astronauts REPRESENTING MSC-Z

DISCUSSED WITH _____ (Contractor Rep) _____ (NASA Rep)

ITEM Seat/harness Arrangement

INQUIRY

Seat and restraint harness arrangement needs further design to achieve necessary restraint with minimum interference. Maximum g loads for all conditions should be defined and justified.

design

REMARKS AND RECOMMENDATION

None of present seat/harness arrangements were felt to be completely satisfactory. Design should consider maximum g loadings, in each direction, that may be experienced (survivable crash or threshold toppling cases). Design should give rather rigid support in area of buttocks as reaction point for body movements from waist up. Design should give consideration to inclusion of back-pads as part of seat, or at least simplified access for donning back-pads. Design should give adequate restraint for ease of operation in zero g condition. Design should provide minimal cockpit cluttering with frames and webbing and should use standup position as an aid in attenuating landing shock

BOARD ACTION

The standup crew position is considered to be approved. Unaided donning of the PLSS should be provided for and preference should be given to doing this in the standup crew station.

CLASS I [X] - GAEC IS DIRECTED TO COMPLY
CLASS II [ ] - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III [ ] - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV [ ] - RETAIN AS DESIRABLE OBJECTIVE
CLASS V [ ] - DISAPPROVED
CLASS VI [ ] - REFERRED

CHANGE MOCK-UP NO [ ] YES [X]

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MOCK-UP DESIGNATION M-1 DATE 9-16-63

SUBMITTED BY J. P. Loftus REPRESENTING MSC

DISCUSSED WITH ~~H. Cherman~~ (Contractor Rep) ~~Paul R. Penrod~~ (NASA Rep)

ITEM Display Panels No. 4
INQUIRY

REMARKS AND RECOMMENDATION

The location of certain of the controls and displays in the inboard area of the windows is unsatisfactory. Suggest relocation of pyrotechnic switching group-right selector in accesable. Move Range-Range Rate displays and LOS displays down. Move master warning lights to more favorable position.

BOARD ACTION

Refer to Chit No. 4-4.

CLASS I ☐ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☒ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☐

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DATE 9-18-63
CHIT NO. 4-2

MOCK-UP DESIGNATION M-1 DATE 9-16-63

SUBMITTED BY Hays/Correale REPRESENTING CSD/MSC

DISCUSSED WITH J. M. Rigsby (Contractor Rep) Paul R. Penrod (NASA Rep)

ITEM Display Panels (4)

INQUIRY

Hand holds on Display Panels need redesign and/or relocation.

REMARKS AND RECOMMENDATION

The hand holds in mock-up when used encourages accidental switch throwing with or without space suit glove.

BOARD ACTION

GAEC to comply.

CLASS I ☒ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☒

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DATE 9-18-63
CHIT NO. 4-3

MOCK-UP DESIGNATION M-1 DATE 9-17-63

SUBMITTED BY ~~Thomas P. Stafford~~ REPRESENTING ~~MSC/Z~~

DISCUSSED WITH _____ ~~George C. Franklin~~
(Contractor Rep) (NASA Rep)

ITEM

INQUIRY

Instrumentation and communications control panel should be combined and integrated to match C/M Panel. The control panel and antenna dials should be removed to area that is not prime panel space.

REMARKS AND RECOMMENDATION

SEE # 4-4

BOARD ACTION

Refer to Chit No. 4-4.

CLASS I ☐ - GAEC IS DIRECTED TO COMPLY
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CLASS V ☐ - DISAPPROVED
CLASS VI ☒ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☐

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MOCK-UP DESIGNATION M-1 DATE 9-17-63

SUBMITTED BY M. S. Carpenter REPRESENTING MSC/Z

DISCUSSED WITH _____ _____
(Contractor Rep) (NASA Rep)

ITEM Cockpit Layout

INQUIRY

Prime panel space is not given to prime displays and controls.

REMARKS AND RECOMMENDATION

More attention should be given to efficient scan patterns; high usage and/or critical controls and displays should be in the most readily accessable areas; and, where possible, layout of LEM should reflect layout of C/M. Many possibilities for combination and integration of controls exist.

BOARD ACTION

~~GAEC to comply.~~

CLASS I ☒ - GAEC IS DIRECTED TO COMPLY
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CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☒

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MOCK-UP INSPECTIONS

PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 4-5

MOCK-UP DESIGNATION M-1 DATE 9-17-63

SUBMITTED BY M. S. Carpenter REPRESENTING MSC/Z

DISCUSSED WITH _____ (Contractor Rep) _____ (NASA Rep)

ITEM Switches

INQUIRY

Critical switches not guarded.

REMARKS AND RECOMMENDATION

Guard or flush mount all critical switches which could be accidentally operated during egress/ingress or during normal crew movement.

BOARD ACTION

~~GAEC to comply~~

CLASS I ☒ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☒ YES ☐

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 4-6

MOCK-UP DESIGNATION M-1 DATE 9-17-63

SUBMITTED BY M. S. Carpenter REPRESENTING MSC/Z

DISCUSSED WITH _____ (Contractor Rep) _____ (NASA Rep)

ITEM Flight Instruments

INQUIRY

Two complete flight stations are required by the mission.

REMARKS AND RECOMMENDATION

Provide each crewman with a complete flight instrument panel including eight ball and thrust to weight ratio gage.

BOARD ACTION

MSC and GAEC shall continue to work towards an early determination of the degree of redundant flight control capability required. The determination shall be based on mission profiles, task analysis, failure analysis, flight simulations to assess crew performance, weight trade-offs in relation to equipment reliability, crew safety and mission success.

CLASS I ☐ - GAEC IS DIRECTED TO COMPLY
CLASS II ☒ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☒ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☒ YES ☐

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 4-7

MOCK-UP DESIGNATION M-1 DATE 9-17-63

SUBMITTED BY Astronauts REPRESENTING MSC/Z

DISCUSSED WITH _____ (Contractor Rep) _____ (NASA Rep)

ITEM Cockpit Nomenclature

INQUIRY

Switch and display labeling confusing and inconsistent.

REMARKS AND RECOMMENDATION

Revise labels.

BOARD ACTION

~~Revise labels.~~

CLASS I ☒ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☒

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 4-8

MOCK-UP DESIGNATION ~~M-1~~ DATE 9-17-63

SUBMITTED BY ~~Astronauts~~ REPRESENTING MSC/Z

DISCUSSED WITH _____ (Contractor Rep) _____ (NASA Rep)

ITEM
INQUIRY ~~Two-man Extravehicular capability.~~

Two-man extravehicular capability should be provided.

REMARKS AND RECOMMENDATION

Provisions should be made for full freedom of two-man extravehicular operations. Contingency requirements as well as more flexible surface operations dictate this requirement. This should be provided in personnel equipment and in LEM systems design for auto-monitoring and systems warning broadcasts.

BOARD ACTION

Not within the scope of this review. Referred to MSC in-house resolution.

CLASS I ☐ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☒ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☐

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 4-9

MOCK-UP DESIGNATION LEM M-1 DATE 9-17-63

SUBMITTED BY Astronauts REPRESENTING MSC - Z

DISCUSSED WITH _____ (Contractor Rep) _____ (NASA Rep)

ITEM Helium Injection Switch Location

INQUIRY

Analyze operation of Helium switch and necessity for time-critical operation.

REMARKS AND RECOMMENDATION

If time-critical operation is involved, location should be evaluated as to suitability.

BOARD ACTION

~~GAEC to comply~~

CLASS I ☒ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☒

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 4-10

MOCK-UP DESIGNATION M-1 DATE 9-17-63

SUBMITTED BY L. D. Paige REPRESENTING NASA

DISCUSSED WITH John C. Stark (Contractor Rep) L. D. Paige (NASA Rep)

ITEM Displays Cross Needle

INQUIRY

Incorrect labeling of needle pointers.

1. "LOS Elev. and Cross Range" refer to vertical needle and should be placed next to this needle.
2. "LOS Az. and Bearing" refer to horizontal needle and should be placed next to this needle.
3. LOS rate needles El. and Az; labeling should be reversed.

REMARKS AND RECOMMENDATION

BOARD ACTION

GAEC to revise labels.

CLASS I ☒ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☒

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 4-11

MOCK-UP DESIGNATION M-1 DATE 9-17-63

SUBMITTED BY R. E. Day REPRESENTING MSC

DISCUSSED WITH John C. Stark (Contractor Rep) R. E. Day (NASA Rep)

ITEM Thrust to Weight Display Placement.

INQUIRY

To ensure a more appropriate viewing of the thrust to weight display it is suggested that it be relocated. It should be interchanged with the Inj. and Monitor Select switches.

REMARKS AND RECOMMENDATION

BOARD ACTION

Refer to Chit No. 4-4

CLASS I ☐ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☒ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☐

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 5-1

MOCK-UP DESIGNATION M-1 DATE 9-16-63

SUBMITTED BY P. R. Knaff REPRESENTING BELLCOMM

DISCUSSED WITH H. Sherman (Contractor Rep) J. Shows (FCOD,MSC) (NASA Rep)

ITEM (5) Hand Controller (Right hand) (Attitude controller)

INQUIRY

Mockup F, using the "cage" ~~or~~ or the "bar stool" restraint requires the pilot to grasp the right hand controller (attitude controller) with his wrist in an awkward position. This is because the controller is perpendicular to the floor, but in either "stand-up" restraint mentioned above the pilots' forearm makes about a 45° angle with the floor. To grasp the controller in the current "neutral" position requires that the wrist be cocked back a considerable extent-rendering a pitch-up maneuver difficult.

REMARKS AND RECOMMENDATION

It is recommended that the stick be repositioned so that, in its neutral position, it lies in a plane approximately perpendicular to the axis of the forearm.

BOARD ACTION

~~GAEC to comply.~~

CLASS I ☒ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☒

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 5-2

MOCK-UP DESIGNATION M-1 DATE 9-16-63

SUBMITTED BY J. P. Loftus REPRESENTING MSC

DISCUSSED WITH W. Peterson (Contractor Rep) Paul R. Penrod (NASA Rep)

ITEM Hand Controller No. 5

INQUIRY

REMARKS AND RECOMMENDATION

Hand controller location appears inadequate. The tranlational controller in particular is so mounted as to require full arm movement which is incompatible with requirements for vernier control in touch down and in LEM active docking modes.

BOARD ACTION

~~GAEC to comply.~~ GAEC should provide an acceptable means accomplishing the vernier control requirement.

CLASS I [X] - GAEC IS DIRECTED TO COMPLY
CLASS II [ ] - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III [ ] - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV [ ] - RETAIN AS DESIRABLE OBJECTIVE
CLASS V [ ] - DISAPPROVED
CLASS VI [ ] - REFERRED

CHANGE MOCK-UP NO [ ] YES [X]

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 5-3

MOCK-UP DESIGNATION M-1 DATE 9-16-63

SUBMITTED BY J. P. Loftus REPRESENTING MSC

DISCUSSED WITH W. Peterson (Contractor Rep) Paul R. Penrod (NASA Rep)

ITEM Hand Controlers (Armrest) No. 5

INQUIRY

REMARKS AND RECOMMENDATION

The present suggestion of an arm rest is inadequate. It would appear that an arm rest with support for the arm both down and to the side is required. The rest might be more effectively located in the region between 3 inches forward of the elbow and the wrist but behind the suit glove to sleeve connection. The rest might be more easily mounted to the cage than the console.

BOARD ACTION

Refer to Chit No. 3-5 and 5-4.

CLASS I ☐ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☒ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☐

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 5-4

MOCK-UP DESIGNATION M-1 DATE 9-18-63

SUBMITTED BY E. H. White REPRESENTING MSC

DISCUSSED WITH _____ _____
(Contractor Rep) (NASA Rep)

ITEM Attitude Controller - Armrest.

INQUIRY

REMARKS AND RECOMMENDATION

The attitude control inputs are limited to wrist movements. The present arm rest does not provide adequate support to make precise control inputs.

BOARD ACTION

Improved arm restraint (particularly for the attitude controller) shall be accomplished by GAEC in conjunction with meeting the requirements of Chit No. 3-5.

CLASS I ☒ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☒

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 6-1

MOCK-UP DESIGNATION M-1 DATE 9-17-63

SUBMITTED BY Astronauts REPRESENTING MSC-Z

DISCUSSED WITH _____ (Contractor Rep) _____ (NASA Rep)

ITEM Window Configuration F

INQUIRY

Window configuration F appears to be adequate, particularly for downward and sideward visibility requirements. Upward visibility requirements may make some additional upward capability desirable.

REMARKS AND RECOMMENDATION

Use of windows for viewing horizon during ascent should be evaluated as to adequacy and accuracy for visual attitude reference. This evaluation may indicate need for more upward visibility.

BOARD ACTION

GAEC to exploit MSC-FCOD study conducted by Ling-Temco-Vought to the extent applicable.

CLASS I ☒ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☒ YES ☐

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 6-2

MOCK-UP DESIGNATION LEM M-1 DATE 9-17-63

SUBMITTED BY Astronauts REPRESENTING MSC - Z

DISCUSSED WITH _____ (Contractor Rep) _____ (NASA Rep)

ITEM Compartment Locks

INQUIRY

Flush locks should be provided to prevent inadvertent actuation of protruding locks.

REMARKS AND RECOMMENDATION

Provide flush locks on all compartments.

BOARD ACTION

Means for preventing inadvertent actuation of locks shall be provided.

CLASS I ☒ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☒ YES ☐

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

PAGE NO.
REPORT NO. LEM-R-63-1
DATE 9-18-63
CHIT NO. 6-3

MOCK-UP DESIGNATION M-1 DATE 9-17-63

SUBMITTED BY Astronauts REPRESENTING MSC/Z

DISCUSSED WITH _____ (Contractor Rep) _____ (NASA Rep)

ITEM AOT Location

INQUIRY

Present location of AOT hampers free movement in cockpit and presents hazard to visor as well as subjecting the instrument to misalignment due to impact with helmet.

REMARKS AND RECOMMENDATION

Relocate AOT, make it retractable, or in some way remove obstruction to crew movement

BOARD ACTION

Due to the integrating of the AOT, IMU and ARA and R/R antenna on a common navigation base for maintaining alignment, relocation of the AOT is not recommended. MSC to investigate means of providing a 9" retraction capability in the design of the GFE AOT. GAECto investigate means of accommodating retraction in the AOT installation provisions.

CLASS I ☒ - GAEC IS DIRECTED TO COMPLY
CLASS II ☒ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED
CLASS VI ☐ - REFERRED

CHANGE MOCK-UP NO ☐ YES ☒

9-17-63

SEP 16-18,

GRUMMAN
LEM M-1

MOCK-UP REVIEW

GRUMMAN AIRCRAFT ENGINEERING CORPORATION

BETHPAGE, NEW YORK

MODEL M-1

LUNAR EXCURSION MODULE

MOCKUP REVIEW & INSPECTION

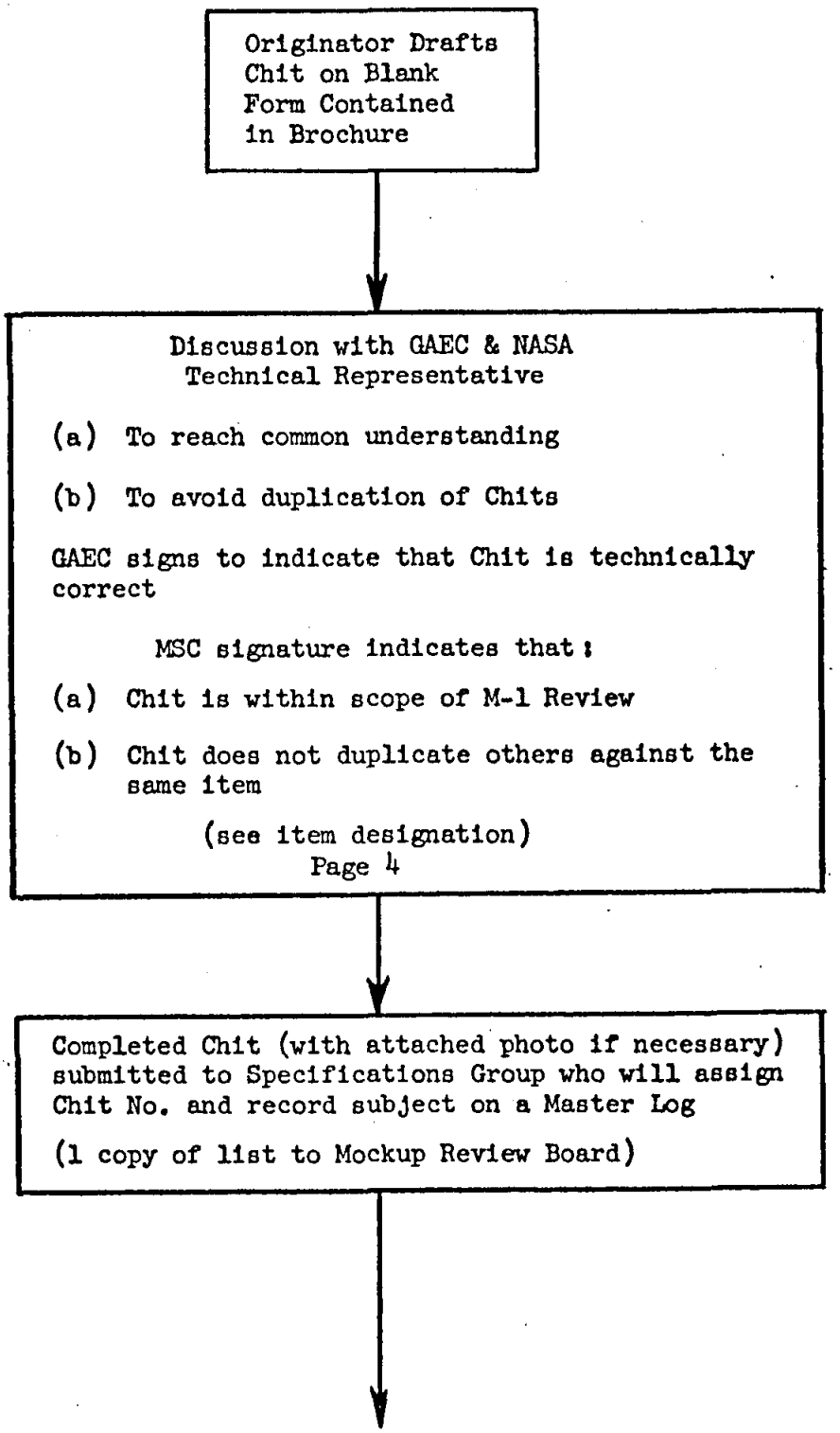
16 SEPTEMBER THRU 18 SEPTEMBER 1963

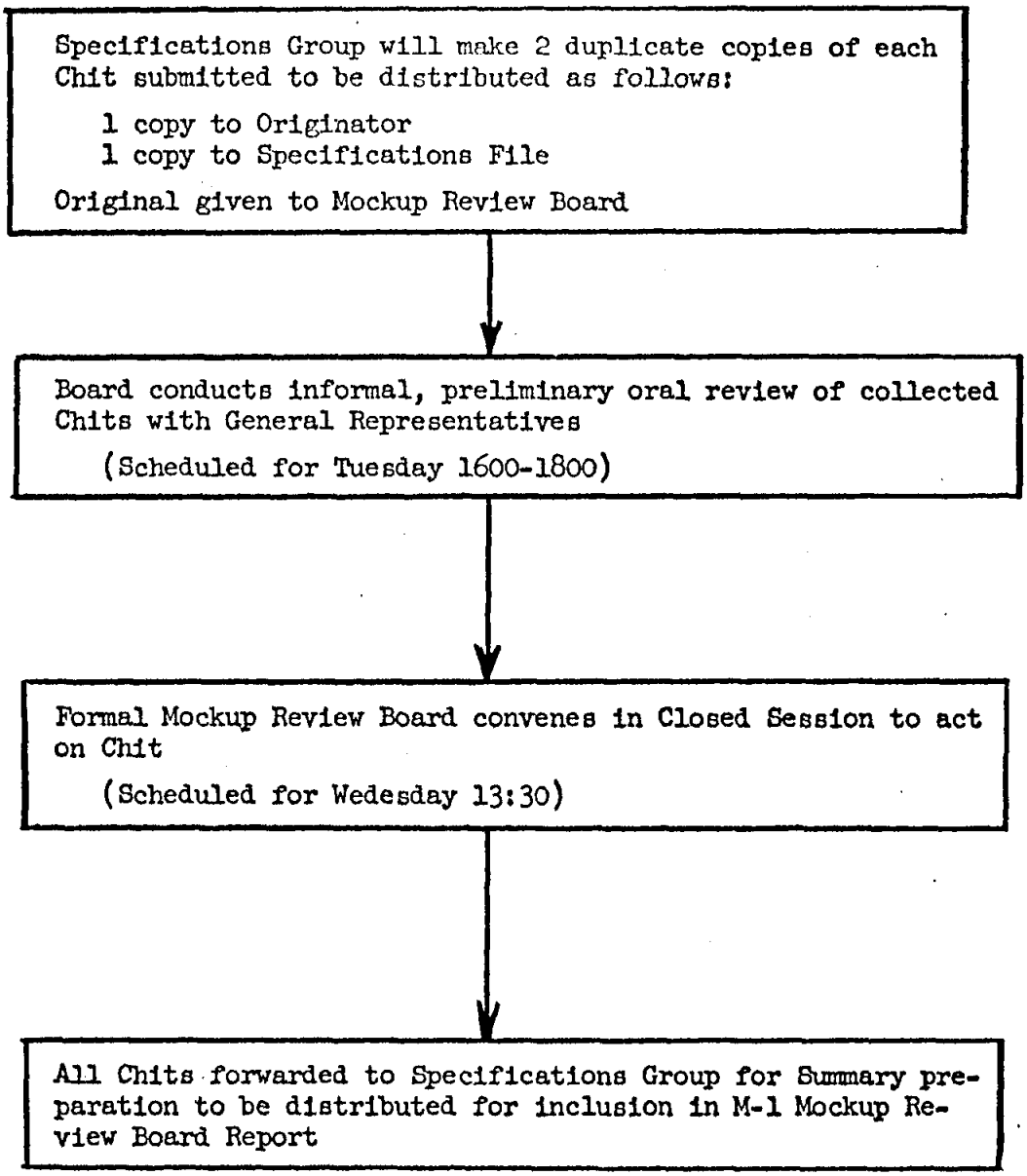
REQUEST FOR CHANGE OR FURTHER STUDY

(CHIT)

PROCEDURE

All recommended changes to the M-1 mockup shall be processed as indicated in the flow diagram on the following pages.


Originator Drafts Chit on Blank Form Contained in Brochure
Discussion with GAEC & NASA Technical Representative
(a) To reach common understanding
(b) To avoid duplication of Chits
GAEC signs to indicate that Chit is technically correct
MSC signature indicates that:
(a) Chit is within scope of M-1 Review
(b) Chit does not duplicate others against the same item
(see item designation) Page 4
Completed Chit (with attached photo if necessary) submitted to Specifications Group who will assign Chit No. and record subject on a Master Log
(1 copy of list to Mockup Review Board)


Specifications Group will make 2 duplicate copies of each Chit submitted to be distributed as follows:
1 copy to Originator
1 copy to Specifications File
Original given to Mockup Review Board
Board conducts informal, preliminary oral review of collected Chits with General Representatives
(Scheduled for Tuesday 1600-1800)
Formal Mockup Review Board convenes in Closed Session to act on Chit
(Scheduled for Wedesday 13:30)
All Chits forwarded to Specifications Group for Summary preparation to be distributed for inclusion in M-1 Mockup Review Board Report

ITEM DESIGNATIONS

The space marked "item" on the chit pertains to the particular area of the mocked up vehicle where a change or further study is requested. These areas are identified by the following numbers:

No. 1 - Cockpit Geometry

No. 2 - Seat, Bar Stool and Restraint

No. 3 - Seat, Cage System and Restraint

No. 4 - Display Panels

No. 5 - Controllers

No. 6 - Cockpit, General

No. 7 - Equipment Arrangement

No. 8 - Cabin Arrangement (Mated Halves)

N.A.S.A. INSPECTION AND REVIEW OF

LUNAR EXCURSION MODULE

M-1 MOCK-UP

SEPT. 16, 17, 18, 1963

GRUMMAN AIRCRAFT ENGINEERING CORPORATION

BETHPAGE, LONG ISLAND, N.Y.

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I. INTRODUCTION

M-1 is the first of a series of mock-ups to be constructed for review and evaluation by NASA. M-1 is termed a "Cabin Interior" mock-up and is constructed of wood, cardboard and metal where necessary. No attempt has been made to present the external configuration, except in the front face area.

The mock-up contains a cockpit interior including, walls, floor, hatch, display panels, controllers, seats, window areas, IMU, AOT and personal equipment. The equipment tunnel area contains "black boxes", hatch, engine cover and tunnel floor.

All items in the interior are painted in accordance with a color code for identification of sub-systems.

II. GENERAL INFORMATION

A. OBJECTIVES

The objectives of the M-1 Mock-Up are:

1. To establish a procedure for this and subsequent mock-up reviews.

2. To inspect, review and critique the following:

   (a) Crew visibility
   (b) General location and placement of display panels
   (c) Seating and restraint
   (d) Location and basic type of hand controller
   (e) Hatch arrangement and space allocation for ingress/egress
   (f) Ingress/egress procedures (Demonstration in "Peter Pan" rig)
   (g) Cabin front face, window arrangement
   (h) Crew station arrangement
   (i) Cabin equipment arrangement

3. To accumulate NASA & GAEC comments ("chits") for consideration in formulating a configuration freeze.

B. PERSONNEL LIST

The following is a list of personnel associated with the M-1 mock-up review.

NASA, RASPO PERSONNEL:

NAME	TITLE	SECTION	BADGE COLOR
Neil A. Armstrong	Astronaut - AAO	I	White
R J. Bailey	NASA-MSC	II	White
F.X. Battersby	Business Manager - RASPO	I	White
R.R. Berglund	Chief - SVDB	I	White
Frank Borman	Astronaut - AAO	II	White
Aleck C. Bond	Chief - SEDD	I	White
M. Scott Carpenter	Astronaut - AAO	II	White
James A. Chamberlin	Sr. Engr. - Adv. to Director	I	White
D. C. Cheatham	Chief - FSB	II	White
R. R. Clemence	Asst. Tech. Mgr. - RASPO	I	White
L. Gordon Cooper	Astronaut - AAO	II	White
Charles Conrad, Jr.	Astronaut - AAO	I	White
J. V. Correale	Chief - CEB	I	White
R. E. Day	NASA - MSC	II	White
James L. Decker	Deputy Manager - LEM	II	White
W. R. Durrett	NASA-MSC	I	White
T. J Edwards	NASA-MSC	II	White
Maxime A. Faget	Assistant Director - E & D	II	White
G. C. Franklin	FCOD	I	White

NASA, RASPO PERSONNEL:

NAME	TITLE	SECTION	BADGE COLOR
Walter J. Gaylor	Manager Engineering - RASPO	II	White
Robert R. Gilruth	Director-MSC	I	White
John H. Glynn, Jr.	Astronaut - AAO	II	White
W. D. Green	NASA Headquarters	I	White
Virgil L. Grissom	Astronaut - AAO	I	White
D. Hammock	Deputy Manager - C & SM	I	White
E. L. Hays	Assistant Chief - CSD	II	White
R. C. Henry	NASA Headquarters	II	White
John H. Johansen	Quality Assurance Manager - RASPO	II	White
C. C. Johnson	NASA - MSC	I	White
R. R. Knaff	Bell Comm	II	White
K. S. Kleinknecht	Manager - Mercury Project	I	White
Christopher C. Kraft	Chief - FOD	II	White
J. B. Lee	Apollo Support - Liaison	II	White
J. Loftus	Training - ASPO	I	White
James A. Lovell	Astronaut - AAO	I	White
G. M. Low	NASA Headquarters	I	White
Owen E. Maynard	Manager - LEM Engineering	I	White
James A. McDivitt	Astronaut - AAO	II	White
E. McLaughlin	NASA Headquarters	I	White
L. N. McMillion	Crew Systems - ASPO	II	White
J. L. Neal	Contracting Officer	I	White
Robert Newlander	Assistant Flight Systems - RASPO	II	White
Warren J. North	Chief - FCOD	I	White
L. D. Paige	NASA Headquarters	I	White
P. R. Penrod	LEM - Engineering	I	White
R. O. Piland	Manager - APOLLO	II	White
R. Prichard	NASA Headquarters	I	White
W. F. Rector III	Assistant Manager - LEM Engineering	I	White
Elliott M. See	Astronaut - AAO	I	White
J. F. Shea	NASA Headquarters	I	White
Alan B. Sheppard, Jr.	Astronaut - AAO	II	White
Walter M. Schirra, Jr.	Astronaut - AAO	I	White
J. C. Shows	FCOD	II	White
R. C. Sebold	NASA Consultant	I	White
Carlton E. Sisler	NASA - MSC	II	White
Donald K. Slayton	Astronaut - AAO	II	White
John W. Small	Manager - RASPO	I	White
Thomas P. Stafford	Astronaut - AAO	I	White
W. E. Stoney, Jr.	Chief - STD	II	White
B. K. Thomas	NASA Headquarters	II	White
Bernard Weinflash	Assistant Flight Systems - RASPO	II	White
Edward H. White II	Astronaut - AAO	I	White
Walter C. Williams	Deputy Director - MR & FO	II	White
John W. Young	Astronaut - AAO	II	White

GRUMMAN AIRCRAFT ENGINEERING CORPORATION, BETHPAGE, LONG ISLAND, NEW YORK

NAME	TITLE	SECTION	BADGE COLOR
L. R. Grumman	Chairman of the Board	I	White
E. C. Towl	President	II	White
W. T. Schwendler	Vice President	II	White
L. B. Evans	Vice President	I	White
R. Hutton	Vice President	I	White
G. F. Titterton	Vice President	I	White
J. G. Gavin	Vice President	I	White
I. G. Hedrick	Vice President	II	White
A. J. Zusi	Vice President	II	White
R. S. Mullaney	Program Manager	II	White
F. X. Canning	Ass't. Program Manager	I	White
C. W. Rathke	Engineering Manager	II	White
T. J. Kelly	Project Engineer	I	White
R. M. Carbee	Subsystems Project Engineer	II	White
A. B. Whitaker	Systems Project Engineer	I	White
A. D. Anderson	Program Administrator	I	White
W. Baldwin	Supervisor - LEM	None	White
R. Bernstein	Specifications	None	White
W. Bischoff	Vehicle Des. & Integration	II	White
L. Brazel	Crew Provisions	None	Tan
W. Bruning	Manufacturing Manager	I	White
S. Campbell	Crew Systems	II	White
J. Carroll	Business Development	I	White
R. Clark	Presentation	I	White
M. Dandridge	Propulsion	None	Green
F. Doennebrink	Flight Controls	I	White
F. Elliot	ECS	None	Green
B. Evans	Quality Assurance	II	White
S. Ferdman	Business Development	I	White
W. Fildstedt	Superintendent	None	White
P. Gardner	Systems Coordination	None	Green
B. Gaylo	Instrumentation	None	Green
E. Griffin	Communications	None	Green
G. Harms	Crew Provisions	I	White
G. Henderson	Navigation & Guidance	None	Green
R. Hilderman	Structural Analysis	II	White
C. Imrie	Plane News	None	White
J. Iverson	Electrical Power	None	Green
L. Junnen	Mechanical Design	None	Green
A. Katz	Thermodynamics	None	Green
G. Kaelin	Lighting	None	Green
J. Kingfield	Quality Control Manager	II	White
W. Craft	Vehicle Co-ordinator	I	White
J. Lentini	Contracts	I	White
F. Luick	Mock-up Co-ordinator	None	White
F. Martins	Crew Provisions	None	Green
B. Masterson	Plane News	None	Tan
D. McCloughan	ECS	I	White

GRUMMAN AIRCRAFT ENGINEERING CORPORATION, BETHPAGE, LONG ISLAND, NEW YORK (CONT'D)

NAME	TITLE	SECTION	BADGE COLOR
C. Meyer	Business Development	II	White
R. Milligan	Motion Picture	None	White
T. Moorman	Test & Support Manager	I	White
J. Morrissey	Specifications	None	White
J. Moylan	Crew Equip & Integration	I	White
J. Orchard	Motion Picture	None	White
L. Paulsrud	Vehicle Design Integration	I	White
W. Petersen	Subsystems Administrator	II	White
W. Peterson	Crew Provisions	I	White
R. Phillips	Vehicle Design Integration	II	White
R. Plunkett	Electronics	None	White
J. Puig	Crew Systems	I	White
S. Raeihle	Inspection	II	White
E. Reeck	Vehicle Design Integration	None	Green
J. M. Rigsby	Crew Provisions	II	White
F. Rowley	Director of Flight Test	I	White
J. Russell	Stabilization & Control	None	Green
S. Salina	Weight Control	None	Green
H. Schaefer	Plane News	None	Tan
Dr. S. A. Schwartz	Crew Systems	II	White
H. Sherman	Crew Systems	I	White
W. Smith	Displays	None	Green
R. K. Smyth	Consulting Pilot	II	White
J. Snedeker	Business Manager	I	White
R. Spinner	Ground Support Equipment	None	Green
E. Stern	System Analysis & Integ.	II	White
T. Stewart	Shop Project Manager	I	White
R. Stone	Crew Provisions	II	White
J. Strakosch	Vehicle Design Integration	None	Green
V. Sturiale	Mechanical Design	None	Green
P. Thorjusen	Vehicle Design Integration	None	Green
J. Wallace	Assistant Superintendent	None	White
O. Williams	Reaction Controls	None	Green

BADGE COLOR CODE

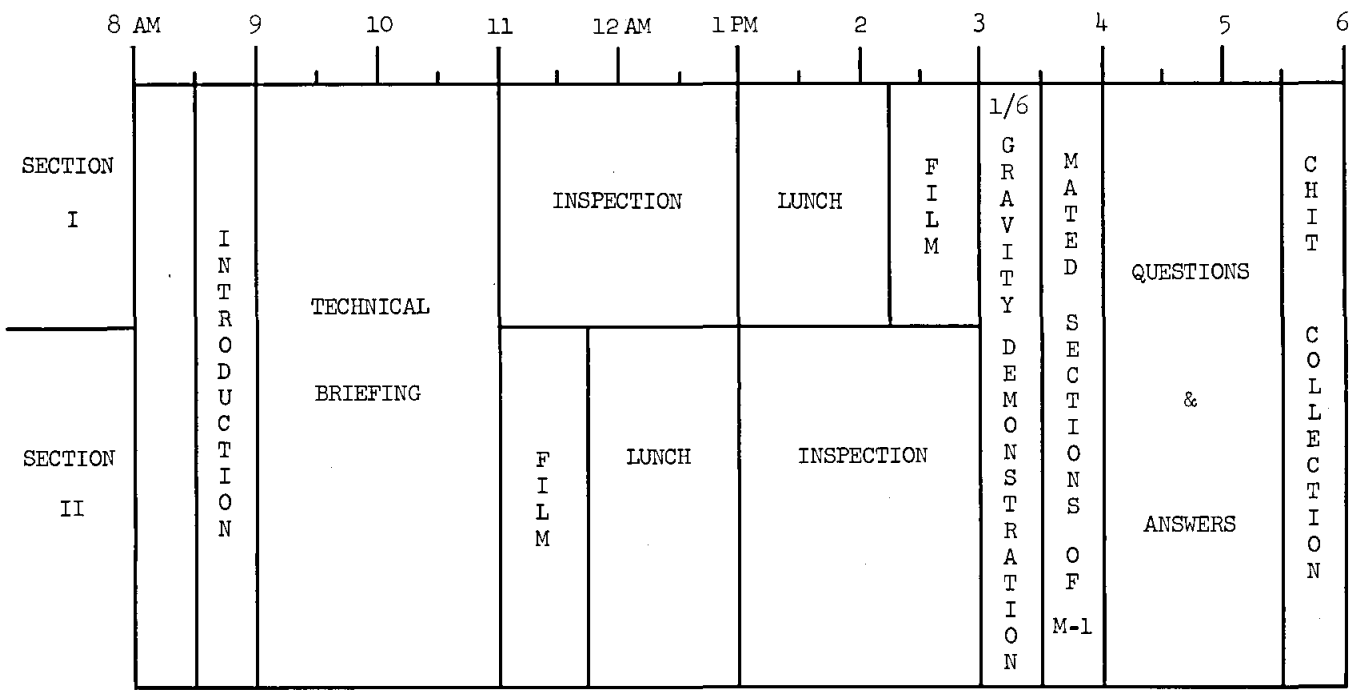
White - Permitted in Mezzanine Classroom and Mock-Up Area
Tan - Permitted in Mock-Up area only
Green - On Stand-By Call-Permitted in Mezzanine Classroom and Mock-Up area when required.

C. Schedule

SEPTEMBER 16 - MONDAY

PRE-MOCK-UP REVIEW

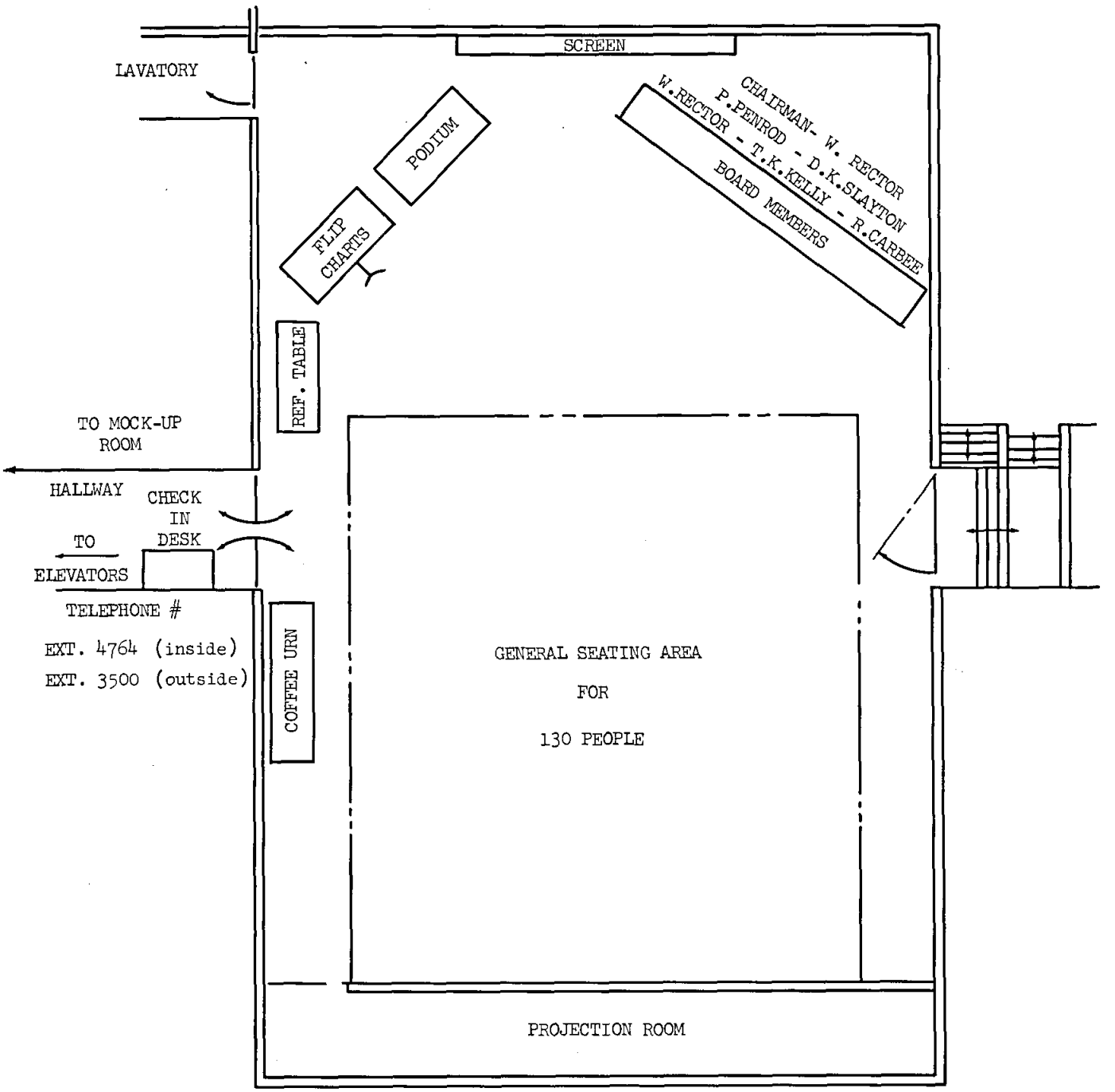
SEPTEMBER 17 - TUESDAY



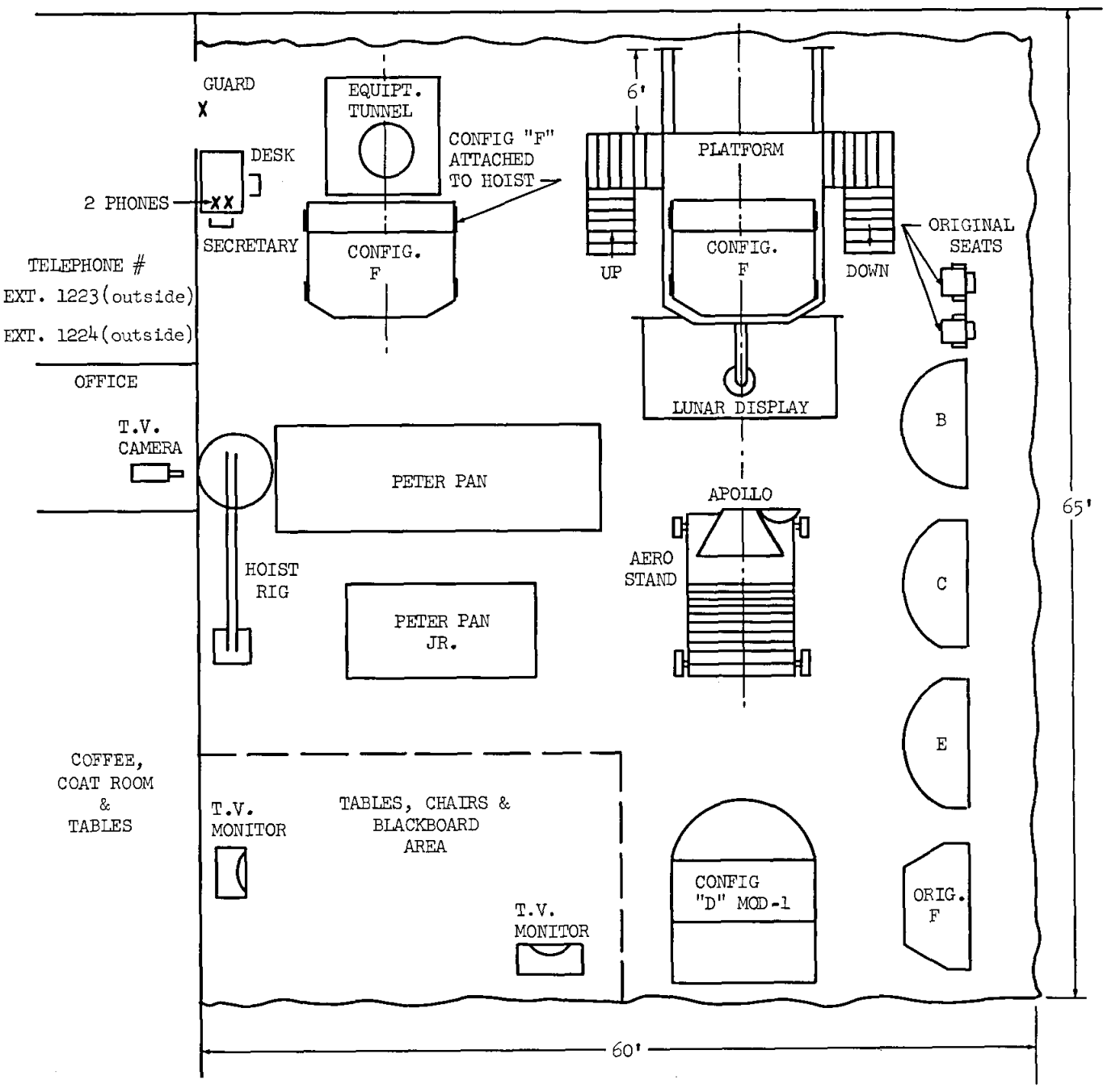
SEPTEMBER 18 - WEDNESDAY

BOARD REVIEW

D. Presentation Room Floor Plan



E. Mock-Up Room Floor Plan



III. DETAIL PRESENTATION

A. Ascent Configuration - W. Bischoff, Vehicle Design Integration

1. Description of LEM vehicle to date - general
2. Detail description of ascent stage
3. Structural reasons the front face is shaped as shown
4. Structural and weight justification for window shape
5. Docking tunnel location, size and shape

B. Crew Station and Arrangement - J. M. Rigsby/R. Stone, Crew Provisions

1. M-1 Mock-up description
2. Geometry and arrangement
3. Seat arrangement and alternates
4. Display panel arrangement
5. Controller location and motion
6. IMU, AOT location and useage
7. Equipment Arrangement

C. Visibility Requirements - H. Sherman, Crew Systems

1. Flight paths and vehicle attitudes
2. Ambient Light - Earth/Sun shine
3. Recognition/detection of target area
4. Footprint
5. Hover to touchdown
6. Mobility
7. Visual aids

IV. MOCK-UP REVIEW

A. Items available for Review

1. The cockpit section of M-1 ascent stage located on top of a 12-foot stand. A portion of the command module is located in front of the LEM cockpit to simulate the Rendezvous and Docking phase. A display of the lunar surface is located on the shop floor below the cockpit representing the view at hover 1,000 feet above the local vertical.

2. Equipment tunnel sections of M-1 mock-up.

3. M-1 mock-up complete. The cockpit section in item 1 is removed from the platform, placed on the shop floor and mated with the equipment tunnel (item 2).

4. Cockpit section of alternate configuration "D" (Mod. -1) (reference only).

5. Three (3) Seat and Restraint systems.

   a) Conventional seat and restraint system installed in configuration "D" (Mod. -1).

   b) Bar stool seating with parachute type harness installed in configuration "F".

   c) Cage and webbing system installed in configuration "F" (to be installed after the bar stools are removed).

   d) "Peter Pan" demonstration with test subject.

   e) Frontal faces of configurations "B", "C", "E", and original "F".

   f) Two conventional seats - full forward tilt.

   g) Drawings, models, photos, etc.

B. Parameters for Evaluation and Review

In order to evaluate the M-1 mock-up, some guide lines are required. Following is a list of items that should be specifically reviewed and critiqued. Specification MIL-M-8650A (WEP) was used as a reference for these recommended evaluation parameters.

1. COCKPIT GEOMETRY

a. Cross-sectional diameter - 92"
b. Cockpit length - 40 5/8"
c. Floor location
d. Sub floor location and shape
e. Floor to ceiling height (hatch up)
f. Floor to ceiling height (hatch down)
g. Aisle width (bar stool stowed)
h. Aisle width (bar stool in place)
i. Aisle width (cage in place)

j. Aisle width (cage in rotated position)
k. Visibility and eye position
l. Hatch, location, actuation and stowage
m. Ingress/egress thru forward docking tunnel

2. Seat (Bar Stool and Restraint)

a. Overall arrangement
b. Seat pan - size, angle, location and height adjustment
c. Foot rest adjustment
d. Position of man in seat
e. System Engineer seat rotation
f. Position of System Engineer in outboard position
g. Bar stool stowage
h. Lap belt position, attachment and adjustment
i. Body restraint concept
j. Body restraint attachment to structure
k. Body restraint attachment to body and adjustment
l. Position of body when restraint not used (facing forward)
m. Position of body when restraint not used (facing outboard)
n. Accessibility to displays (fully restrained)
o. Accessibility to displays (lap belt restraint only)
p. Operation of controllers (fully restrained)
q. Operation of controllers (lap belt restraint only)
r. Accessibility of personnel equipment

3. Seat (Cage System and Restraint)

a. Overall arrangment
b. Shape, size and location of cage
c. Height adjustment (at hip location)
d. Foot rest adjustment
e. Customized cage feasibility (will delete c and d)
f. Harness arrangement - attachment to seat, shoulder attachment, adjustment
g. Position of man in cage
h. System Engineer seat rotation
i. Position of System Engineer in outboard position
j. Position and freedom of body when shoulder harness not used
k. Accessibility to displays (fully restrained)
l. Accessibility to displays (only hip connection fastened)
m. Operation of controllers (fully restrained)
n. Operation of controllers (only hip connection fastened)
o. Inboard rotation of cages
p. Accessibility of personnel equipment
q. Use of cage as bed, litter, etc.

4. Display Panels

a. General arrangement of panel areas
b. Placement, size, reach and view of main center panel
c. Placement, size, reach and view of canted main panel
d. Placement, size, reach and view of lower front panels
e. Placement, size, reach and view of upper front panels

f. Placement, size, reach and view of Commanders side console
g. Placement, size, reach and view of System Engineers side panels
h. Location of flight parameter displays
i. Location and grouping of sub-system displays (general)

5. Controllers

a. Location of attitude controllers
b. Motion of attitude controller
c. Location of translation/thrust controller
d. Motion of translation/thrust controller
e. Spacing between controllers with reference to body

6. Cockpit General

a. Visibility from design eye
b. Visibility from lean forward eye
c. Location of I.M.U.
d. Removal of I.M.U.
e. Location of back-up guidance package
f. Location of A.O.T.
g. Use of A.O.T. from center aisle station
h. Restraint system for using A.O.T. in space
i. Forward hatch location and shape
j. Motion of hatch from closed to open position
k. Location of PLSS
l. Accessibility of PLSS
m. Location and accessibility of food, water, waste, etc.
n. Ingress/egress through forward docking ring

7. Equipment Arrangment

a. Tunnel size
b. Engine cover size and location
c. Overhead hatch location and actuation
d. Equipment location and installation
e. Access to equipment
f. Equipment arrangement

8. Cabin Arrangement (mated halves)

a. Overall arrangement of interior
b. Aisle width
c. Access into flight station
d. Steps up to tunnel area
e. Access into overhead docking tunnel
f. Mobility
g. Operation of forward hatch

C. "Peter Pan" Test Procedure Work Sheet

The following pages contain the test procedure followed by test subjects when going thru the "Peter Pan" 1/6th gravity demonstrator.

For today's demonstration the "script" will be followed as closely as possible, time being the limiting factor.

Members of the reviewing team are asked to read the test procedure and follow the sequences step by step. At the end of each group of sequences are a series of "evaluation" questions. These items for evaluation should be used in formulating any chits for the mock-up review.

CREW PROVISIONS ENGINEERING STUDIES NO. C. P. - 14

1/6th GRAVITY TEST DEMONSTRATOR "PETER PAN"

WORK SHEET:

TEST # 11

CONDUCTED BY:

1) GENE W. HARMS
2) DR. S.A. SCHWARTZ
3) W.W. PETERSON
4) L. BRAZEL

TESTED BY:

1) R.K. SMYTH
2) .....

EQUIPMENT:

1) APOLLO PROTOTYPE SPACE SUIT
2) PETER PAN HOIST
3) PORTABLE LIFE SUPPORT SYSTEM
4) COMMUNICATIONS
5) AIRBOTTLES AND TEST STAND
6) SCALE (WEIGHING)

FACTS:

1. THE BASIC PETER PAN DEMONSTRATOR WAS MODIFIED AS FOLLOWS:

   a) AN ADDITIONAL FLUSH HAND GRIP WAS ADDED TO THE BOTTOM INSIDE SURFACE OF THE FORWARD DOCKING RING TO IMPROVE MOVEMENT IN AND OUT OF THIS AREA.

   b) THE FULL LENGTH NYLON ROPE GRIPS WERE REMOVED. THESE ROPES WERE A FAIR TO POOR ASSISTANCE FOR ENTERING THE COCKPIT FROM THE FORWARD DOCKING RING, BUT WERE USELESS WHEN CRAWLING OUT BACKWARDS THROUGH THE DOCKING RING.

   c) THE MECHANISM FOR LIFTING THE FORWARD HATCH UP IN A "WINDOW SHADE" MANNER HAS BEEN REMOVED.

   d) THE FALSE FLOOR PROVIDED FOR STORING THE LOOSE FORWARD HATCH BELOW HAS BEEN REMOVED.

CREW PROVISIONS ENGINEERING STUDIES NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

e) IN LIEU OF ITEMS (c) AND (d) A HINGED DOWN HATCH HAS BEEN INSTALLED. THE DOOR OPENS BY PULLING THE TOP PORTION OF IT AFT AND DOWN. THE DOOR STOWS FLAT ON THE MAIN FLOOR AND BELOW THE FALSE FLOOR. A LATCH MECHANISM HOLDS THE HATCH IN THE OPEN POSITION. A FOOT PEDAL RELEASE FREES THE DOOR TO RAISE IT UP TO THE CLOSED POSITION. TO SIMULATE A SPRING LOADED DOOR A COUNTERWEIGHT SYSTEM HAS BEEN INCORPORATED.

f) THE NYLON BRAIDED ROPE REMOVED IN STEP (b) HAS BEEN REPLACED BY TWO HAND RAILS ON THE OUTSIDE SURFACE OF THE HATCH. WHEN THE HATCH IS LOCKED DOWN THE HANDRAIL PLACEMENT PROVIDES A GOOD AID IN INGRESS AND EGRESS THROUGH THE FORWARD HATCH.

g) A FALSE FLOOR HAS BEEN ADDED ABOVE THE MAIN FLOOR. THE FLOOR IS CUT OUT TO ACCEPT THE HATCH IN THE STOWED POSITION AND PROVIDES A FOOT STEP WHEN OPERATING THE DOOR FROM OPEN TO CLOSED POSITION AND FROM CLOSED TO OPEN POSITION. THE FLOOR ALSO PROVIDES A STEP WHEN CLIMBING.

h) THE LADDER FROM THE COCKPIT FLOOR UP TO THE ENGINE COVER WAS REMOVED. A FOLD DOWN STEP HAS BEEN ADDED TO BULKHEAD Z = 22 IN ITS PLACE.

i) A FLOOR SURFACE HAS BEEN ADDED TO THE EQUIPMENT TUNNEL AREA.

j) A STEP HAS BEEN ADDED TO THE FORWARD RIGHT HAND SIDE OF THE ENGINE COVER. THE COVER HAS BEEN INCREASED TO 28" DIAMETER (WAS 26").

k) THE FIXED OVERHEAD HATCH WAS REPLACED WITH A MOVEABLE HINGE DOWN HATCH. SIMPLE HATCHES WERE ADDED TO HOLD THE HATCH UP.

l) THE FIXED LATCH/LADDER ON THE UNDER SIDE OF THE UPPER HATCH WAS REMOVED AND REPLACED WITH A SLIDING LATCH/LADDER ON THE TOP SIDE OF THE HATCH. THE LADDER ROTATES 90° TO UNLOCK, SLIDES DOWN AND THEN IS ROTATED 90° AGAIN TO LOCK IT IN THE EXTENDED POSITION.

m) A BOLT DEVICE FOR SECURING THE UPPER HATCH WAS SIMULATED. EIGHT BOLTS WERE LOCATED AROUND THE PERIPHERY OF THE HATCH. BY TURNING EACH BOLT ABOUT 3 TURNS THE LOCKING AND UNLOCKING METHOD CAN BE SIMULATED.

n) A SPECIAL TOOL WAS MADE TO OPERATE THE BOLTS IN THE OVERHEAD HATCH. DUE TO LIMITATIONS IN REACH IN A PRESSURIZED SUIT A TOOL THAT BRINGS THE ARM MOTION DOWN IS REQUIRED.

o) THE TRUNK TYPE HANDLES WERE REMOVED FROM THE SIDES OF THE EQUIPMENT BAY PANELS AND REPLACED WITH FAIRLY RIGID LEATHER STRAPS. THE HANDLES WERE CRABBED AS BEING TOO SMALL. THE STRAPS PROVIDE MORE FINGER ROOM AND ARE MORE FLEXIBLE THAN THE RIGID HANDLES REMOVED.

CREW PROVISIONS ENGINEERING STUDIES NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

p) THE PROTRUDING FIXED STEPS/HAND RUNGS WERE REMOVED FROM THE UPPER DOCKING RING. THESE WERE CRABBED AS INTERFERING WITH EGRESS OUT THROUGH THIS AREA. THE BACK PACK ON THE SUBJECT FORCES HIS HELMET FORWARD UP AGAINST THE STEP/HAND RUNGS. A FLUSH STEP/HAND RUNG AND A SPRING LOADED INTERNAL STEP/HAND RUNG WERE ADDED IN LIEU OF THOSE REMOVED. EACH TYPE OF STEP/HAND RUNG IS TO BE EVALUATED.

q) THE TWO (2) INCH ADDITION TO THE HEIGHT OF THE ENGINE COVER HAS BEEN REMOVED TO REFLECT THE LATEST HEIGHT OF THIS UNIT INTO THE TUNNEL AREA.

r) "BLACK" BOXES HAVE BEEN ADDED TO THE AFT BULKHEAD IN THE EQUIPMENT TUNNEL. THE PETER PAN HOIST RIG CANNOT BE USED IN THIS AREA FOR EVALUATION. AS A RESULT A PETER PAN JUNIOR HAS BEEN CONSTRUCTED WHICH PROVIDES FOR PASSAGE OF THE HOIST CABLE INTO THIS AREA. ALL THE BLACK BOXES IN THIS AREA ARE MOUNTED ON SIMULATED COLD PLATES. THE BOXES HAVE HINGED COVERS TO DEMONSTRATE ACCESSIBILITY TO THE MODULES IN THE BOX ITSELF.

s) THE FORWARD FACE OF THE EQUIPMENT TUNNEL HAS BEEN EXTENDED TO Z = +22. THIS CHANGE REFLECTS THE INTERIOR ARRANGEMENT OF THE ACTUAL CABIN AREA. IN DOING THIS THE FLOOR AREA IN THE TUNNEL HAS ALSO EXTENDED FORWARD. THIS AREA SERVES AS A STEP WHEN CLIMBING UP FROM THE COCKPIT INTO THE EQUIPMENT TUNNEL.

t) THE LOWER PORTION OF THE INSTRUMENT PANEL WAS ADDED IN THE AREA ABOVE THE FORWARD HATCH DOOR.

u) THE SILHOUETTE OUTLINE OF THE SIT DOWN SEAT WAS ADDED SO AS TO SIMULATE THE AVAILABLE AISLE SPACE. THE ARM RESTS ARE PLACED IN THE STOWED POSITION. THE TEST WILL BE RUN ALSO WITH THE ARM REST REMOVED FOR COMPARISON.

PURPOSE OF TEST:

a) EVALUATE ALL ITEMS ADDED ABOVE.

b) PERMIT NASA AS WELL AS G.A.E.C. PERSONNEL OPPORTUNITY TO PERFORM TEST IN THE DEMONSTRATOR.

c) OBTAIN PHOTOGRAPHIC DOCUMENTATION OF TESTS FOR PRESENTATION AT MOCK-UP MEETING.

CREW PROVISIONS ENGINEERING STUDIES NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

PROCEDURE:

PART I

1. PUT ON PRESSURE SUIT, HELMET, HARNESS, PORTABLE LIFE SUPPORT SYSTEM AND PETER PAN HOIST AND COMMUNICATION CONNECTIONS.

2. STAND IN FRONT OF SIMULATOR AND INFLATE SUIT TO 3.5 P.S.I.

3. WEIGH SUBJECT.

4. SUSPEND SUBJECT FROM HOIST AND CHECK WEIGHT. SUSPENDED WEIGHT SHOULD BE 1/6 OF ORIGINAL WEIGHT.

5. APPROACH THE RUNG LADDER AND GRASP BOTH HAND RAILS ON FORWARD PLATFORM.

6. CLIMB UP LADDER ONTO FORWARD PLATFORM.

EVALUATE:

a) DISTANCE BETWEEN LADDER RUNGS - (12") .....
.....

b) PITCH ANGLE OF LADDER - (15°) .....
.....

c) ACCESS ONTO FORWARD PLATFORM .....
.....

d) EFFICIENCY, PLACEMENT AND SIZE OF THE TWO HAND RAILS ON PLATFORM .....
.....

e) SIZE OF PLATFORM - LENGTH AND WIDTH (32 x 40) .....
.....

7. STOOP FORWARD AND LEAN INTO THE 32" DIAMETER FORWARD DOCKING RING. REACH FORWARD AND PUSH HATCH DOOR DOWN ONTO COCKPIT FLOOR. MAKE SURE LATCHES ENGAGE HATCH AND HOLD IT OPEN.

8. PULL SELF THROUGH RING INTO COCKPIT USING THE TWO FLUSH HAND GRIPS IN THE TUNNEL AND THE RAILS ON THE DOOR AS AIDS. WHEN IN THE COCKPIT, STAND UP IN -Z DIRECTION.

CREW PROVISIONS ENGINEERING STUDIES NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

NOTE: CONDUCT STEP 8 WITH THE ARM RESTS ON THE SEAT IN THE STOWED POSITION. THIS WILL SIMULATE THE AISLE WIDTH EXISTING WITH THE SIT DOWN TYPE OF SEATS.
DO STEP 8 AGAIN, ONLY THIS TIME WITH THE ARM RESTS REMOVED. THIS WILL SIMULATE THE AISLE WIDTH OBTAINABLE WITH A SEAT HAVING NO ARM RESTS.
THE AISLE WIDTH WITH THE BAR STOOL AND CAGE CONCEPT WILL BE EVEN GREATER.

EVALUATE:

a) HEIGHT DIFFERENTIAL BETWEEN FORWARD DOCKING RING AND FORWARD PLATFORM (22 inches). IS IT TOO HIGH OR LOW - WHAT IS SUGGESTED HEIGHT?.....
.....

b) LOCATION AND EFFECTIVENESS OF FLUSH HAND GRIPS IN FORWARD DOCKING RING.....
.....

c) LENGTH OF TUNNEL - TOO LONG, TOO SHORT? .....
.....

d) EFFORT REQUIRED IN OPENING FORWARD HATCH AND LOCKING IT ON COCKPIT FLOOR.....
.....

e) WHAT TYPE OF HANDLE IS SUGGESTED FOR OPENING HATCH?.....
.....

f) DIAMETER OF TUNNEL (32" I. D.).....
.....

g) CLEARANCE OF BACK PACK IN DOCKING RING TUNNEL.....
.....

h) LOCATION AND EFFECTIVENESS OF HAND GRIPS ON TOP SIDE OF STOWED HATCH
.....
.....

i) AISLE WIDTH WITH STOWED ARM RESTS .....
.....

j) AISLE WIDTH WITH OUT ARM RESTS.....
.....

k) EFFORT REQUIRED TO GET ON FEET IN COCKPIT.....
.....

CREW PROVISIONS ENGINEERING STUDIES NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

l) ARE FURTHER HAND GRIPS REQUIRED IN ENTERING COCKPIT?.....
.....

m) DOES THE EXPOSED SURFACE OF THE DOOR HAVE TO BE SMOOTH OR CAN THERE BE PROTRUSIONS SUCH AS LOCKING MECHANISM, HANDLES, ETC.?.....
.....

9. TURN AROUND 180° AND FACE IN +Z DIRECTION, STEP BACKWARDS UP ON FALSE FLOOR BEHIND STOWED DOOR. STAND IN A SPREAD EAGLE FASHION.

10. STEP ON RELEASE PIN AND ALLOW DOOR TO SWING UP TO THE CLOSED POSITION.

11. STEP DOWN TO MAIN COCKPIT FLOOR.

12. DETERMINE TYPE OF DEVICE THAT COULD BE ACTUATED IN LOCKING THE HATCH.

EVALUATE:

a) EFFORT IN TURNING AROUND IN COCKPIT.....
.....

b) EFFORT IN STANDING UP ON FALSE FLOOR.....
.....

c) EFFORT IN STANDING IN "SPREAD EAGLE" FASHION.....
.....

d) EFFORT IN RELEASING DOOR HATCH.....
.....

e) ROOM ALLOWED FOR SWINGING HATCH FROM OPENED TO CLOSED POSITION.....
.....
.....

f) MOVEMENT ON MAIN COCKPIT FLOOR.....
.....

g) TYPE OF LOCKING DEVICE FOR FORWARD HATCH.....
.....

13. TURN AROUND 180° AND FACE IN -Z DIRECTION.

14. STEP UP ON FALSE FLOOR.

CREW PROVISIONS ENGINEERING STUDIES NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

15. USING SPECIAL TOOL PROVIDED GO THROUGH MOTIONS OF UNBOLTING DOOR. PLACE TOOL IN PLACE AND TURN EACH BOLT 3 - 4 FULL REVOLUTIONS. THESE BOLTS DO NOT UNFASTEN ANYTHING BUT SIMPLY SIMULATE MOTIONS AND EFFORT REQUIRED TO UNBOLT THE HATCH. REMOVE THE TOOL THEN REACH UP AND UNLATCH THE OVERHEAD HATCH.

16. LOWER UPPER HATCH AND AT THE SAME TIME EXTEND THE FOOT STEP LOCATED ON THE TOP SIDE OF THE HATCH.

EVALUATE:

a) USE OF FALSE FLOOR AS A STEP FOR WORKING ON OVERHEAD HATCH.....
.....

b) CAN THE UNBOLTING PROCEDURE BE DONE FROM THE MAIN FLOOR RATHER THAN THE FALSE FLOOR.....
.....

c) EFFECTIVENESS OF SPECIAL TOOL.....
.....

d) EFFORT IN UNBOLTING ALL EIGHT BOLTS. IS ANY ONE MORE OF A PROBLEM THAN ANOTHER?.....
.....

e) EFFORT IN UNLATCHING HATCH.....
.....

f) EFFORT IN SWINGING HATCH DOWN AND EXTENDING FOOT STEP.....
.....

17. SWING STOWED STEP DOWN FROM TUNNEL TO FORWARD FACE OF BULKHEAD Z + 22.

18. STEP UP ON FALSE FLOOR WITH RIGHT FOOT.

19. USE HAND GRIPS PROVIDED AND STEP UP ON EXTENDED STEP WITH LEFT FOOT.

20. STEP UP ON TUNNEL FLOOR WITH RIGHT FOOT AND THEN LEFT FOOT.

21. STEP UP WITH LEFT FOOT ON SIDE STEP ON RIGHT HAND SIDE OF ENGINE COVER.

22. STEP UP ON TOP SIDE OF ENGINE COVER WITH RIGHT FOOT AND THE LEFT FOOT. DURING THESE MANUEVERS BEND LOW SO THAT THE BACK PACK WILL NOT SNAG ON THE OVERHEAD CEILING.

23. USING STEPS PROVIDED ON HATCH AND DOCKING RING CLIMB UP THROUGH THE DOCKING RING.

24. CLIMB UP AND STAND ON TOP LIP OF THE OVERHEAD DOCKING RING. HOLD ONTO THE HAND GRIPS PROVIDED.

CREW PROVISIONS ENGINEERING STUDIES NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

EVALUATE:

a) LOCATION, ACTUATION AND PLACEMENT OF THE STOWED STEP .....
.....

b) USE OF FALSE FLOOR AS AN INITIAL STEP .....
.....

c) USE OF STOWED STEP .....
.....

d) EFFORT IN GETTING UP ONTO TUNNEL FLOOR .....
.....

e) EFFECTIVENESS OF SIDE STEP ON ENGINE COVER .....
.....

f) EFFORT IN GETTING UP ONTO ENGINE COVER .....
.....

g) CLEARANCES OF BACK PACK WHEN CLIMBING ON TO ENGINE COVER .....
.....

h) LOCATION AND EFFECTIVENESS OF STRAPS AS HAND GRIPS .....
.....

i) EFFORT IN CLIMBING UP HATCH .....
.....

j) EFFECTIVENESS OF FLUSH STEP IN DOCKING TUNNEL .....
.....

k) EFFECTIVENESS OF FOLDING STEP IN DOCKING TUNNEL .....
.....

l) DIAMETER OF OVERHEAD DOCKING TUNNEL (32" I. D.) .....
.....

m) EFFECTIVENESS AND HEIGHT OF EXTERNAL HAND GRIP (39" ABOVE TOP LIP OF OVERHEAD DOCKING RING) .....
.....

25. WHILE STANDING ON TOP LIP OF UPPER DOCKING RING, TURN AROUND 180° AND FACE IN +Z DIRECTION.

26. CLIMB DOWN TO UPPER PLATFORM USING THE TWO STEPS PROVIDED. STEP DOWN WITH RIGHT FOOT FIRST.

CREW PROVISIONS ENGINEERING STUDIES NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

EVALUATE:

(a) EFFORT REQUIRED TO TURN AROUND 180° ON DOCKING RING LIP .....

(b) SPACING AND PITCH OF STEPS. (APPROXIMATELY 9" VERTICAL STEPS) .....

(c) LOCATION AND POSITION OF SIDE RAILS ON UPPER PLATFORM .....

(d) SIZE OF PLATFORM (32 x 34) .....

27. STEP BACKWARDS ON UPPER PLATFORM TO AFT EDGE.

28. STEP DOWN ON TWO RUNG LADDER, RIGHT FOOT FIRST, TO LOWER PLATFORM.

29. HOLDING ON TO RAILS, STEP BACK ON LOWER PLATFORM TO AFT EDGE.

30. STEP DOWN ON NINE RUNG LADDER, RIGHT FOOT FIRST, TO SHOP FLOOR.

31. STEP AWAY FROM LADDER.

EVALUATE:

(a) EFFECTIVENESS OF UPPER PLATFORM RAILS .....

(b) LOCATION OF FIRST RUNG ON LADDER .....

(c) SPACING OF RUNGS ON 2 RUNG LADDER ($10\frac{1}{4}$") .....

(d) PITCH OF 2 RUNG LADDER (15°) .....

(e) SIZE OF LOWER PLATFORM (32 x 33) .....

(f) EFFECTIVENESS OF LOWER PLATFORM RAILS .....

(g) LOCATION OF FIRST RUNG ON LONG LADDER .....

CREW PROVISIONS ENGINEERING STUDIES NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

EVALUATE: (CONTINUED)

(h) PITCH OF NINE RUNG LADDER (17°) .....
.....

(i) SPACING OF RUNGS ON NINE RUNG LADDER (12") .....
.....

32. STEP UP TO LONG LADDER

33. CLIMB UP LONG LADDER ONTO LOWER PLATFORM

34. STEP FORWARD ON LOWER PLATFORM AND CLIMB UP SHORT 2 RUNG LADDER ONTO UPPER PLATFORM.

35. STEP FORWARD ON UPPER PLATFORM AND STAND UP AGAINST UPPER DOCKING RING. SIMULATE REACH INTO TUNNEL AS IF TRYING TO OPEN THE UPPER HATCH.

36. STEP FORWARD ON UPPER PLATFORM AND CLIMB UP THE TWO STEPS ONTO LIP OF THE UPPER DOCKING RING.

EVALUATE:

(a) APPROACH TO LADDER ON SHOP FLOOR .....
.....

(b) EASE OF CLIMBING UP RUNGS TO FIRST PLATFORM .....
.....

(c) EFFECTIVENESS OF RUNGS FOR USE AS HAND GRIPS .....
.....

(d) EASE OF GAINING ACCESS TO LOWER PLATFORM .....
.....

(e) EFFECTIVENESS OF HANDRAILS ON LOWER PLATFORM .....
.....

(f) MOBILITY ON LOWER PLATFORM .....
.....

(g) APPROACH TO THE 2 RUNG LADDER .....
.....

(h) EASE OF CLIMBING UP TWO RUNGS TO UPPER PLATFORM .....
.....

CREW PROVISIONS ENGINEERING STUDIES NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

EVALUATE: (CONTINUED)

(i) EASE OF GAINING ACCESS TO UPPER PLATFORM .....
.....

(j) EFFECTIVENESS OF HANDRAILS ON UPPER PLATFORM .....
.....

(k) APPROACH TO THE TWO VERTICAL STEPS .....
.....

(l) EASE OF CLIMBING UP THE TWO VERTICAL STEPS AND ONTO THE TOP LIP OF THE UPPER DOCKING RING .....
.....

(m) EFFECTIVENESS OF LENGTHENED HANDRAILS ON UPPER DOCKING RING .....
.....

(n) THE REACH TO THE IMAGINARY UPPER HATCH DOOR .....
.....

37. TURN AROUND 180° ON UPPER DOCKING RING AND FACE IN - Z DIRECTION

38. CLIMB DOWN THROUGH UPPER DOCKING RING ONTO ENGINE COVER

EVALUATE:

(a) EASE OF TURNING AROUND 180° ON UPPER DOCKING RING LIP .....
.....

(b) EASE OF CLIMBING DOWN THROUGH THE TUNNEL .....
.....

(c) EFFECTIVENESS OF FLUSH STEP IN TUNNEL .....
.....

(d) EFFECTIVENESS OF FOLDING STEP IN TUNNEL .....
.....

(e) EFFECTIVENESS OF FIXED STEPS ON HATCH COVER .....
.....

(f) NEED OF STEPS IN THE DOWNWARD MOVEMENT THROUGH THE TUNNEL .....
.....

CREW PROVISIONS ENGINEERING STUDIES NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

EVALUATE: (CONTINUED)

(g) CLEARANCE OF BACK PACK WHEN PASSING DOWNWARD THROUGH THE 32" DIAMETER TUNNEL .....
.....

(h) ANGLE OF STOWED HATCH (APPROXIMATELY 5° FROM VERTICAL) .....
.....

39. WHILE STILL FACING AFT (-Z DIRECTION) EXTEND LEFT FOOT AFT AND DOWN ONTO THE ENGINE COVER STEP.

40. STEP DOWN ON THE EQUIPMENT TUNNEL FLOOR WITH THE RIGHT AND THEN LEFT FOOT.

41. STEP FORWARD AND SUPPORT SELF USING THE STRAPS PROVIDED. EXTEND RIGHT FOOT INTO FOLDABLE STEP ON BULKHEAD Z = 22.

42. EXTEND LEFT FOOT DOWN ONTO FALSE FLOOR IN COCKPIT AND THEN RIGHT FOOT ONTO MAIN FLOOR. STAND ERECT IN COCKPIT WITH BOTH FEET ON MAIN COCKPIT FLOOR. STOW THE FOLDING STEP ONTO THE EQUIPMENT TUNNEL FLOOR.

43. REACH AFT AND GRASP OVERHEAD HATCH. SWING IT TOWARD BODY. STOW THE EXTENDABLE STEP AND LOCK IN PLACE.

44. SWING THE HATCH UP INTO THE CLOSED POSITION AND LOCK IN PLACE USING THE TWO LATCHES PROVIDED.

NOTE: AT THIS TIME GO THROUGH AN IMAGINARY MOTION STUDY. IMAGINE THAT THIS HATCH IS SECURED USING A CRANK TYPE OF HANDLE WHICH DRIVES A GEAR BOX AND IN TURN OPERATES LOCKING SPOKES. REACH UP AND OPERATE THIS IMAGINARY HANDLE ABOUT 13" LONG FROM THE CENTER OF THE HATCH. SWING THE ARM THROUGH A CIRCLE 26" DIAMETER AND ABOUT 8" BELOW BOTTOM SURFACE OF HATCH. ROTATE THE ARM THROUGH APPROXIMATELY FOUR REVOLUTIONS.

45. TURN AROUND 180° AND FACE IN +Z DIRECTION.

46. REACH FORWARD AND SWING FORWARD HATCH OPEN. AS THE HATCH ROTATES DOWN AND AFT STEP BACK ONTO THE FALSE FLOOR. WHEN THE HATCH IS ALMOST ALL THE WAY DOWN, STEP ON THE HATCH AND LOCK IT IN THE OPEN POSITION.

EVALUATE:

(a) EASE OF STEPPING DOWN ON ENGINE COVER STEP .....
.....

(b) EASE OF STEPPING DOWN ON EQUIPMENT TUNNEL FLOOR .....
.....

CREW PROVISIONS ENGINEERING STUDIES NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

EVALUATE: (CONTINUED)

(c) EFFECTIVENESS OF HAND STRAPS PROVIDED .....
.....

(d) EASE OF STEPPING DOWN ON FOLDING STEP .....
.....

(e) EASE OF STEPPING DOWN ONTO FALSE FLOOR .....
.....

(f) EASE OF STEPPING DOWN ONTO MAIN COCKPIT FLOOR AND STOWING STEP.....
.....

(g) EASE OF OPERATING THE IMAGINARY CRANK HANDLE ON HATCH .....
.....

(h) EASE OF TURNING AROUND 180° .....
.....

(i) EASE OF OPERATING HATCH INTO STOWED POSITION .....
.....

47. TURN AROUND 180° AND FACE IN -Z DIRCTION.

48. BEND DOWN AND CRAWL OUT BACKWARDS OUT THROUGH FORWARD DOCKING RING. USE ALL HAND GRIPS PROVIDED.

49. STAND UP ON FORWARD PLATFORM.

50. WALK BACKWARDS ON PLATFORM HOLDING ONTO THE TWO RAILS PROVIDED.

51. STEP DOWN ON RUNG LADDER, RIGHT FOOT FIRST, AND CLIMB DOWN TO SHOP FLOOR.

52. STEP BACK FROM LADDER.

EVALUATE:

(a) EASE OF TURNING AROUND IN COCKPIT .....
.....

(b) EASE OF BENDING DOWN AND KNEELING ON COCKPIT FLOOR .....
.....

(c) AISLE WIDTH OF 25" .....
.....

CREW PROVISION ENGINEERING STUDIES NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

52. (CONTINUED)

EVALUATE: (CONTINUED)

(d) PROBLEMS IN CRAWLING OUT OF FORWARD DOCKING RING .....

(e) EFFECTIVENESS OF HAND GRIPS PROVIDED .....

(f) PROBLEM OF GETTING FEET DOWN TO FORWARD PLATFORM .....

(g) PROBLEM IN GETTING BODY OUT OF TUNNEL AND PLACING BODY IN ERECT POSITION ON PLATFORM .....

(h) EFFECTIVENESS OF DOUBLE HANDRAIL ON PLATFORM AS AN AID FOR STABILIZING BODY .....

(i) EASE OF STEPPING OFF PLATFORM ONTO FIRST RUNG .....

(j) EASE OF CLIMBING DOWN RUNGS ON THE LADDER .....

(k) EASE OF STEPPING AWAY FROM LADDER .....

THIS PORTION OF THE TEST IS COMPLETE

PART II

TEST ON DETERMINING MINIMUM DIAMETER OF RESTRICTION POSSIBLE IN THE EXISTING 32" DIA HORIZONTAL AND VERTICAL TUNNELS. THIS TEST REQUIRED TO DETERMINE FEASIBILITY OF VARIOUS N. A. A. DOCKING SCHEMES.

PROCEDURE:

1) PLACE THE RESTRICTION RING ON THE END OF THE FORWARD DOCKING TUNNEL. THE FIRST RING TO BE TESTED IN THE 27 1/2" I. D. RESTRICTION.

CREW PROVISION ENGINEERING STUDIES NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

PROCEDURE: (CONTINUED)

2) ATTEMPT TO CRAWL THROUGH THE FORWARD DOCKING RING INTO THE COCKPIT. IF NOT POSSIBLE INDICATE SO AND BACK OUT ON THE PLATFORM. IF POSSIBLE CRAWL INTO THE COCKPIT AND THEN CRAWL BACKWARDS OUT TO THE FORWARD PLATFORM.

3) REPEAT THIS PROCEDURE AGAIN WITH THE 29", 30" and 31" DIAMETER RESTRICTING RINGS.

EVALUATE:

a) DETERMINE MINIMUM SIZE ALLOWABLE FOR INGRESS AND EGRESS THROUGH FORWARD DOCKING TUNNEL .....
.....

4) PLACE RESTRICTING RING ON THE TOP LIP OF THE OVERHEAD DOCKING RING. THE FIRST RING TO BE TESTED IS THE $27\frac{1}{2}$" I. D. RESTRICTION.

5) ATTEMPT TO CLIMB UP THROUGH THE OVERHEAD TUNNEL AND UP THROUGH THE RESTRICTION. IF NOT POSSIBLE, CLIMB BACK DOWN ONTO ENGINE COVER. IF POSSIBLE, CLIMB UP TO THE TOP LIP OF THE TUNNEL AND THEN CLIMB BACK DOWN THROUGH THE RESTRICTION ONTO THE ENGINE COVER.

6) REPEAT THIS PROCEDURE AGAIN WITH THE 29", 30" AND 31" DIAMETER RESTRICTING RINGS.

EVALUATE:

(a) DETERMINE MINIMUM SIZE ALLOWABLE FOR INGRESS AND EGRESS THROUGH THE OVERHEAD TUNNEL .....
.....

PART III

TEST ON ACCESS, MAINTENANCE AND WORK AREA IN THE EQUIPMENT TUNNEL. THESE TESTS TO BE CONDUCTED IN "PETER PAN JUNIOR".

PROCEDURE:

1) THE FIRST TEST TO BE ACCOMPLISHED IN AN UNPRESSURIZED SUIT.

2) STAND ON COCKPIT FLOOR AND FACE IN - Z DIRECTION.

3) CLIMB UP STEP AND ONTO ENGINE COVER. BENDING DOWN CRAWL AFT PAST TUNNEL ENGINE COVER.

CREW PROVISIONS ENGINEERING STUDIES NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

PROCEDURE: (CONTINUED)

4) PLACE FEET ON TUNNEL FLOOR AND SIT DOWN ON ENGINE COVER.

5) REACH FOR THE SURFACE OF ALL THE EQUIPMENT ON THE AFT BULKHEAD.

6) REMOVE EACH COMPUTER TRAY FROM THE A. G. C. AND REPLACE.

7) USING A SCREW DRIVER REMOVE A P. S. A TRAY FROM THE A. G. C.

8) PLACE THE TRAY ON THE A. G. C. AND PROCEDE TO REMOVE A MODULE FROM THE TRAY USING A SCREW DRIVER.

9) REPLACE THE MODULE AND THEN REPLACE THE TRAY IN THE A. G. C.

10) DROP SCREW DRIVER ON FLOOR AND RECOVER IT.

11) OPEN UP THE COVERS OF ALL THE OTHER BOXES. GO THROUGH MOTIONS OF REMOVING A MODULE FROM EACH BOX.

12) IN THE BEST MANNER POSSIBLE EGRESS FROM THE TUNNEL INTO THE COCKPIT FLOOR.

EVALUATE:

a. INGRESS ONTO ENGINE COVER .....
.....

b. INGRESS PAST ENGINE COVER AND EASE OF GETTING INTO POSITION OF SITTING ON THE COVER WITH FEET ON THE TUNNEL FLOOR .....
.....

c. REACH TO ALL EQUIPMENT .....
.....

d. REMOVAL OF COMPUTER TRAY AND REPLACEMENT .....
.....

e. REMOVAL OF P. S. A. TRAY .....
.....

f. REMOVAL OF MODULE FROM P. S. A. TRAY AND REPLACEMENT .....
.....

g. REPLACEMENT OF P. S. A. TRAY .....
.....

h. RETRIEVAL OF SCREW DRIVER .....
.....

CREW PROVISIONS ENGINEERING NO. C. P. - 14

WORK SHEET:

TEST # 11 (CONTINUED)

EVALUATE: (CONTINUED)

i. METHOD OF EGRESSING FROM TUNNEL .....
.....

j. PLACEMENT OF ASSIST HANDLES .....
.....

13) Repeat steps 2 through 12 in a pressurized suit (3.5 P. S. I)

EVALUATE:

a) Same as a through j above .....
.....

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
LEM PROJECT
REQUEST FOR CHANGE OR FURTHER STUDY
MOCK-UP INSPECTIONS

CHIT NO. 1 - 1

(Applicable information shall be completely filled in)

MOCK-UP DESIGNATION M-1 DATE 9-17-63

SUBMITTED BY John Flue REPRESENTING NASA, MSC, Houston

DISCUSSED WITH Bill Shoe - Crew Provisions
(Contractor Rep) (NASA Rep)

ITEM Window

INQUIRY (Make complete, concise statements. Use separate sheet for each inquiry.)

An 8" diameter window in the overhead ceiling is required.

SAMPLE

REMARKS AND RECOMMENDATION

Window required for:

1. Provide view of overhead docking ring in case LEM docks to Apollo using overhead ring.
2. Reduce feeling of claustrophobia.
3. Provide vision in upper quadrant for visual sighting of Apollo, stars, etc.

(Do not write below this line)

FOR BOARD USE ONLY

REMARKS:

CLASS I ☐ - GAEC IS DIRECTED TO COMPLY
CLASS II ☐ - MSC CONDUCT DETAILED REVIEW AND RESPOND BY DATE SPECIFIED
CLASS III ☐ - GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED
CLASS IV ☐ - RETAIN AS DESIRABLE OBJECTIVE
CLASS V ☐ - DISAPPROVED

CHANGE MOCK-UP NO ☐ YES ☐
CHANGE SPECIFICATION NO ☐ YES ☐
ESTIMATED WT. (+)_____ lbs. (-)_____ lbs.

SIGNATURE OF BOARD CHAIRMAN

MOCK-UP BOARD SUMMARY

MODEL LEM

MOCK-UP M-1 TM _____

DATE 9-17-63

NOTE: NUMBER IN PARENTHESIS AT END OF RECOMMENDATION IS THE ORIGINAL SERIAL NUMBER ASSIGNED TO THE BLANK "REQUEST FOR CHANGE OR FURTHER STUDY" CHIT FORM.

ITEM	RECOMMENDED CHANGE (AND REASON)	DECISION	CHG. MOCK-UP	CHG. DETAIL SPEC.	EST. WT. CHG. LBS.
1	Recommendation: An 8" diameter window in the overhead ceiling is required - (1-1) Reason: (1) Provide view of overhead docking ring in case LEM docks to Apollo using overhead ring. (2) Reduce feeling of claustrophobia (3) Provide vision in upper quadrant for visual sighting of Apollo, stars, etc.	Disapproved: 1) LEM inactive in overhead docking. 2) Added weight not tolerable.	No	--	--

SAMPLE

F. Comment Sheet

The M-1 mock-up is the first review conducted by GAEC for NASA, MSC, Houston.

The program and schedule of events were worked out jointly between the contractor and NASA. Every attempt has been made to establish a procedure that would produce a smooth flowing review.

One of the objectives of this mock-up is to establish a procedure for conduct of subsequent reviews of this type. It is therefore requested that all constructive criticisms of this review be listed below and returned to the contractor for consideration in planning the next review.

NAME _____ REPRESENTING _____

COMMENTS

PLEASE TEAR THIS SHEET OUT AND RETURN TO THE CONTRACTOR

V. FILM PRESENTATION

The film being shown consists of three study phases conducted by Engineering, as follows:

a) "Peter Pan"

The first series of tests were conducted in a Navy MK IV pressure suit, since the Apollo suit was not available. It can be seen that movements by the subject in the pressurized suit are very limited.

The demonstrator was expanded to show ingress/egress problems both internal and external to the vehicle. The basic problem areas studied are:

1) Climbing up and down ladders
2) Crawling thru horizontal tunnel
3) Climbing thru vertical tunnel
4) Opening and closing hatches
5) Moving about in the cockpit
6) Maintenance of equipment in tunnel area
7) Moving about on external platforms
8) Climbing thru restricted tunnel diameters.

b) Docking Study

During the evolution of front face configurations, studies were made of the vision available to the astronaut during a rendezvous and docking maneuver. A movie camera was located at the pilot's design eye position and aimed straight ahead. The docking portion of the command module was mocked up and mounted on wheels. The C/M was placed 65 feet in front of the LEM window area and then wheeled up to the forward docking ring. The camera focused on the C/M, photographing the sequence from start up to docking.

The docking studies were conducted on frontal configurations "C", "D", "D" (Mod. -1), "E", original "F" and "F".

c) Mobility in Cockpit - Earth Gravity

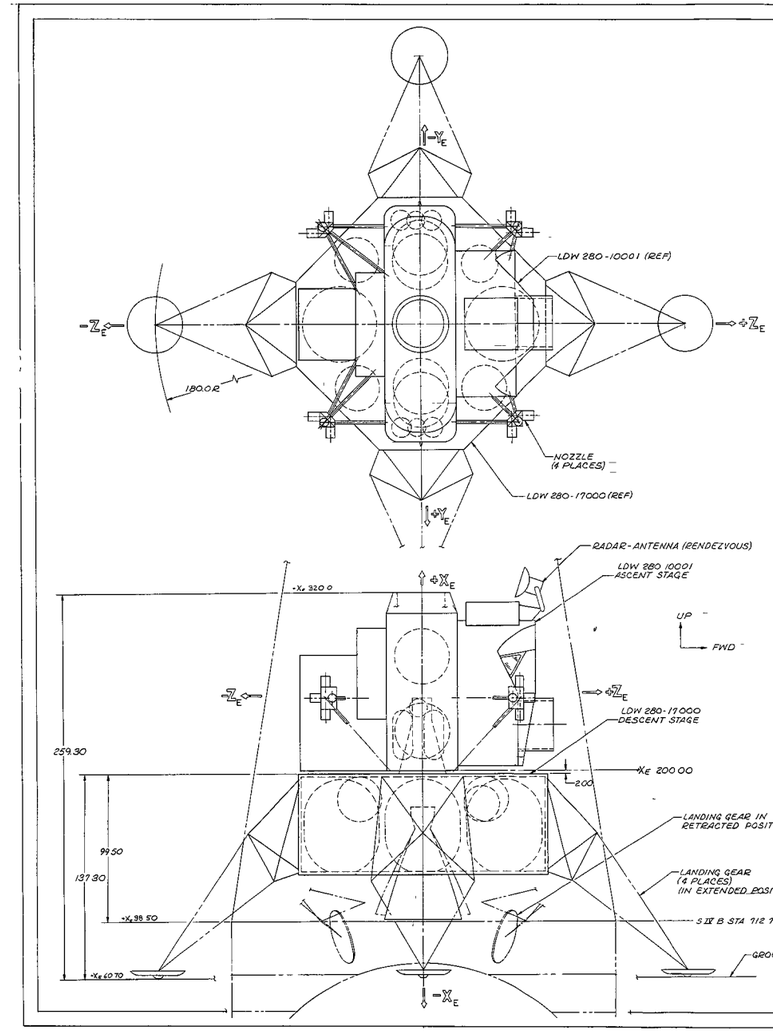
Due to the limited time available for the mock-up review, RASPO suggested that a film should be shown of mobility studies in the cabin with subjects wearing the Apollo space suit. Some of the mobility parameters shown are:

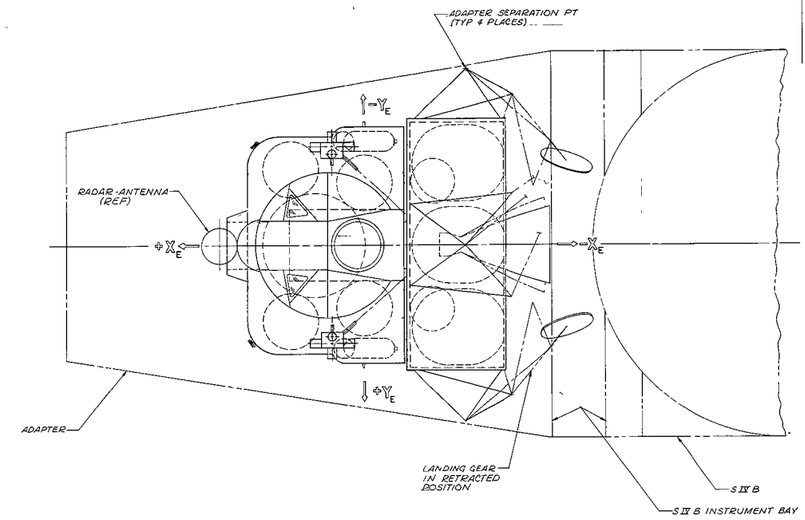
1) Donning Portable Life Support System
2) Donning outer garment
3) Getting in and out of seat, bar stool or cage
4) Opening forward hatch
5) Reaching for display panel
6) Using AOT

VI. DRAWINGS

The following pages are drawings of the M-1 Mock-Up as presented for this review.

	DRAWING NUMBER	DRAWING TITLE
1.	LLO-280-10000	General Arrangement - LEM
2.	LLO-280-17000	General Arrangement - Descent Stage
3.	LLO-280-10001	General Arrangement - LEM - Ascent Stage
4.	LLO-340-119	Inboard Profile - Cockpit & Equipment Bay - Configuration "D" (Mod. -1)
5.	LLO-340-121	Inboard Profile - Cockpit & Equipment Bay - Configuration "F"
6.	LLO-340-116	Cockpit Geometry - Canted Forward Deck - Configuration "D" (Mod. -1)
7.	LLO-340-120	Cockpit Geometry - 65° Canted Frontal Face - Configuration "F"
8.	LLO-340-118	Visibility Geometry - Configuration "D" (Mod. -1)
9.	LLO-340-118	Visibility Diagram - Cockpit - Configuration "D" (Mod. -1)
10.	LLO-340-122	Visibility Geometry - Configuration "F"
11.	LLO-340-122	Visibility Diagram - Cockpit - Configuration "F"
12.	LLO-340-123	Display Panel - Arrangement - Configuration "D" (Mod. -1)
13.	LLO-340-124	Display Panel - Arrangement - Configuration "F"
14.	LLO-340-125	Seat Arrangement - Conventional - Cockpit - Configuration "D" (Mod. -1)
15.	LLO-340-126	Seat Assembly - Bar Stool - Cockpit - Configuration "F"
16.	LLO-340-127	Seat Assembly - Cage - Cockpit - Configuration "F"
17.	Chart	Structural Arrangement - Ascent Stage
18.	Chart	Structural Arrangement - Cabin Face





REVISION

ENGR. APPD.
CO'IT. APPD.

LDW 280-10000

CONTRACT LINE ITEM NO. 1
PRIMARY CODE NO. 001
REFERENCE PARAGRAPH NO OF EXHIBIT E 5.3
CATEGORY TYPE III PER EXHIBIT E

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE UNLESS SPECIFIED FRACTIONS DECIMALS ANGLES

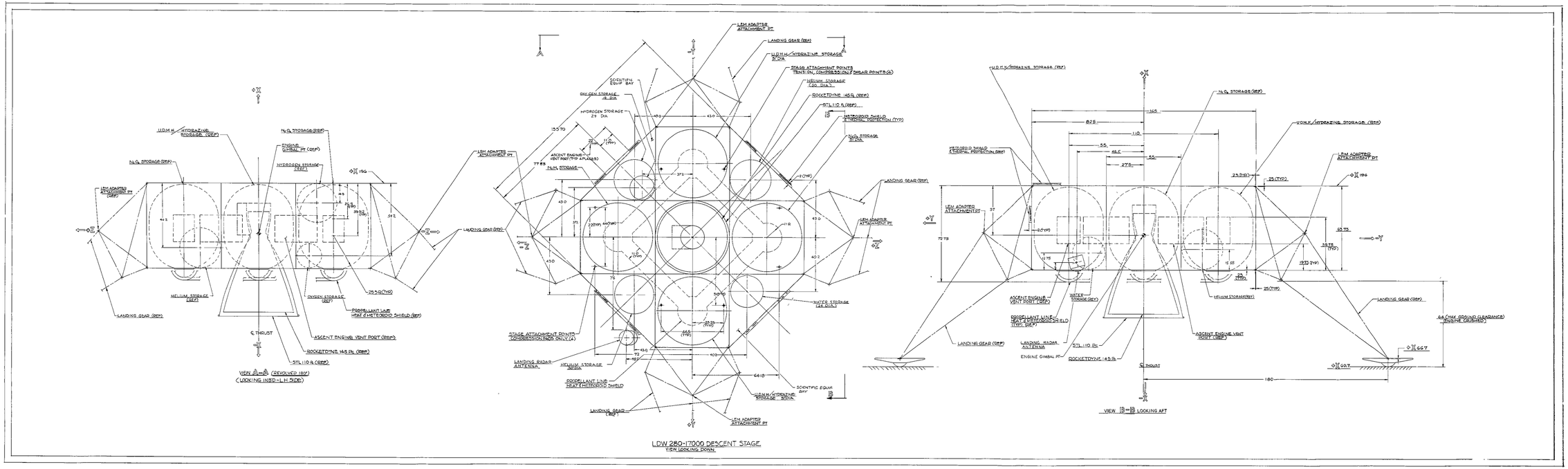
DRAWN BY S TIMBES 8/27/65
LAYOUT BY
CHKD BY

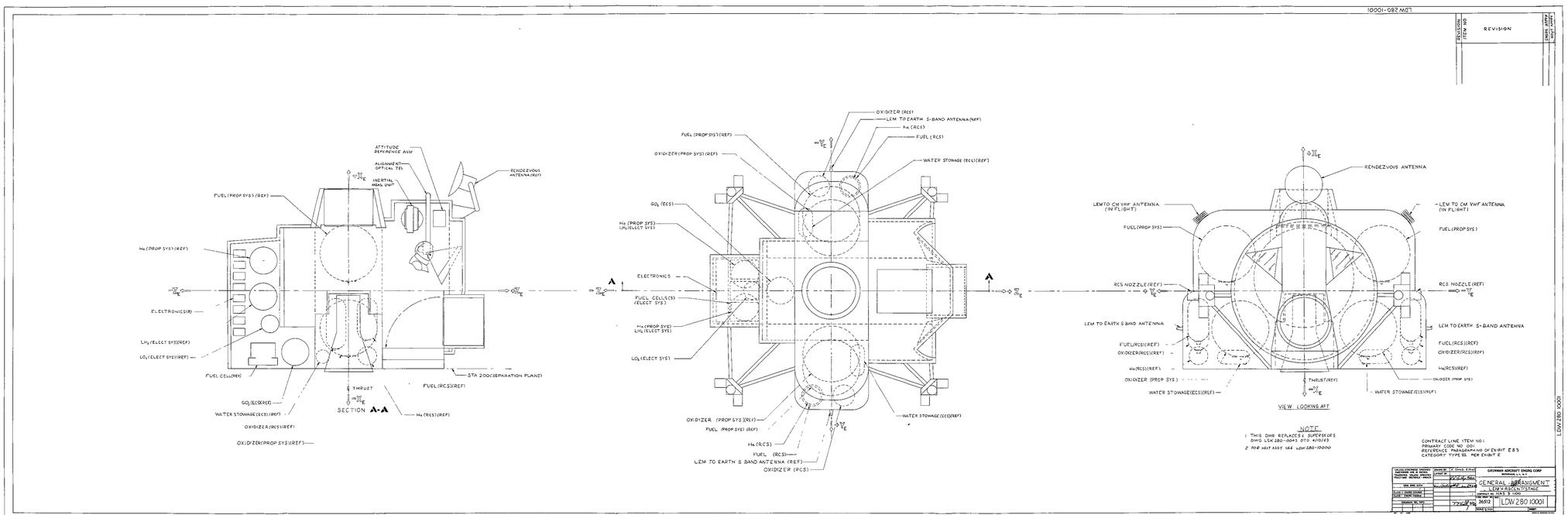
GRUMMAN AIRCRAFT ENGRG CORP
BETHPAGE, L. I., N. Y.

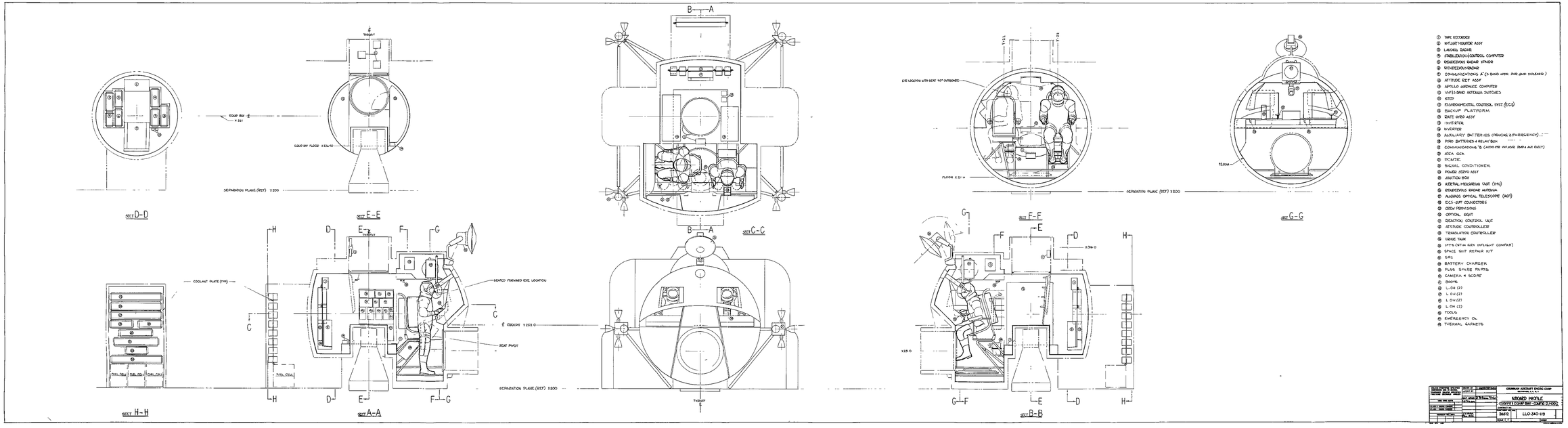
GENERAL ARRANGEMENT
LEM

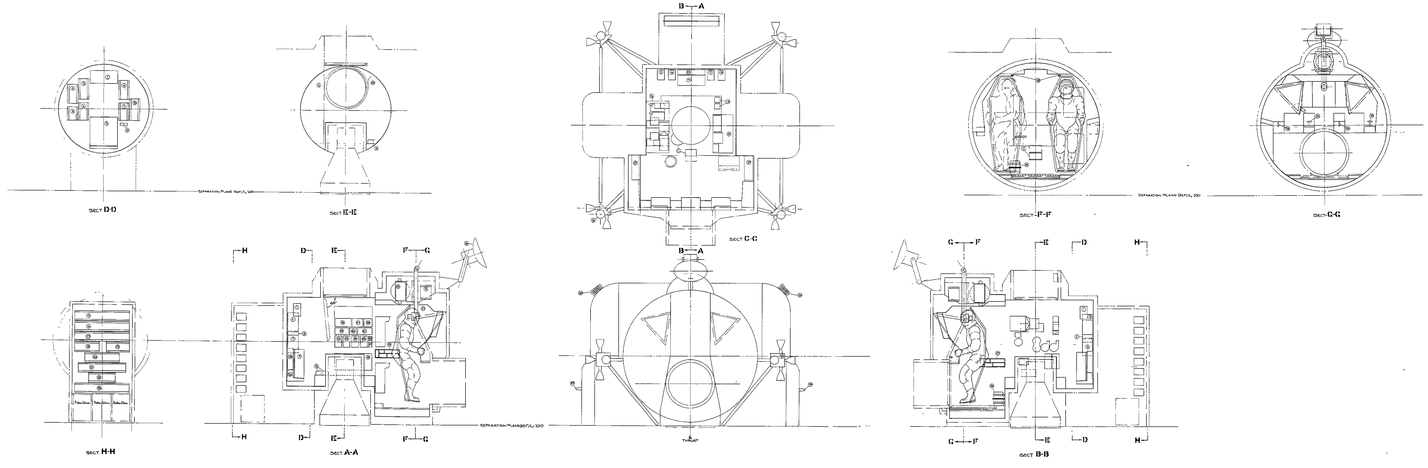
CONTRACT NO NAS 9 1100
DWG. SHEET NO. 001 26512
LDW 280 10000
SCALE 1/20
SHEET

CONG ENG AUTH
CLASS II ENGRG CHANGE
CLASS I ENGRG CHANGE
GRUMMAN REL INFO


LDW 280-17000 DESCENT STAGE
VIEW LOOKING DOWN
VIEW LOOKING AFT
(LOOKING INBD - L.H. SIDE)
LEM ADAPTER ATTACHMENT PT
LANDING GEAR (DEP)
U.D.M.H./HYDRAZINE STORAGE 5 DIA
STAGE ATTACHMENT POINTS TENSION, COMPRESSION & SHEAR POINTS (6)
HELIUM STORAGE (20) DIA.)
ROCKETDYNE (45K) (DEP)
ST.I.10 K (DEP)
METEOROID SHIELD (THERMAL PROTECTION) (TYP)
N2O4 STORAGE SPHERE
SCIENTIFIC EQUIP BAY
OXYGEN STORAGE 18 DIA
HYDROGEN STORAGE 29 DIA
ASCENT ENGINE VENT PORT (TYP 4 PLACES)
N2H4 STORAGE
WATER STORAGE (AT EQUIP)
LEM ADAPTER ATTACHMENT PT
LANDING RADAR ANTENNA
HELIUM STORAGE SPHERE
POGO PLANT LINE HEAT SHIELD
STAGE ATTACHMENT POINTS COMPRESSION ONLY (4)
U.D.M.H./HYDRAZINE STORAGE (DEP)
N2O4 STORAGE (DEP)
ENGINE GIMBAL PT (DEP)
HYDROGEN STORAGE (DEP)
LEM ADAPTER ATTACHMENT PT (DEP)
HELIUM STORAGE (DEP)
OXYGEN STORAGE (DEP)
POGO PLANT LINE HEAT & METEOROID SHIELD (DEP)
ASCENT ENGINE VENT PORT (DEP)
ROCKETDYNE 14.5 K (DEP)
ST.I.10 K (DEP)
℄ THRUST
WATER STORAGE (DEP)
ENGINE GIMBAL PT
ROCKETDYNE 45.5 K
ASCENT ENGINE VENT PORT (DEP)
68 (MAX GROUND CLEARANCE) ENGINE CRUSHED

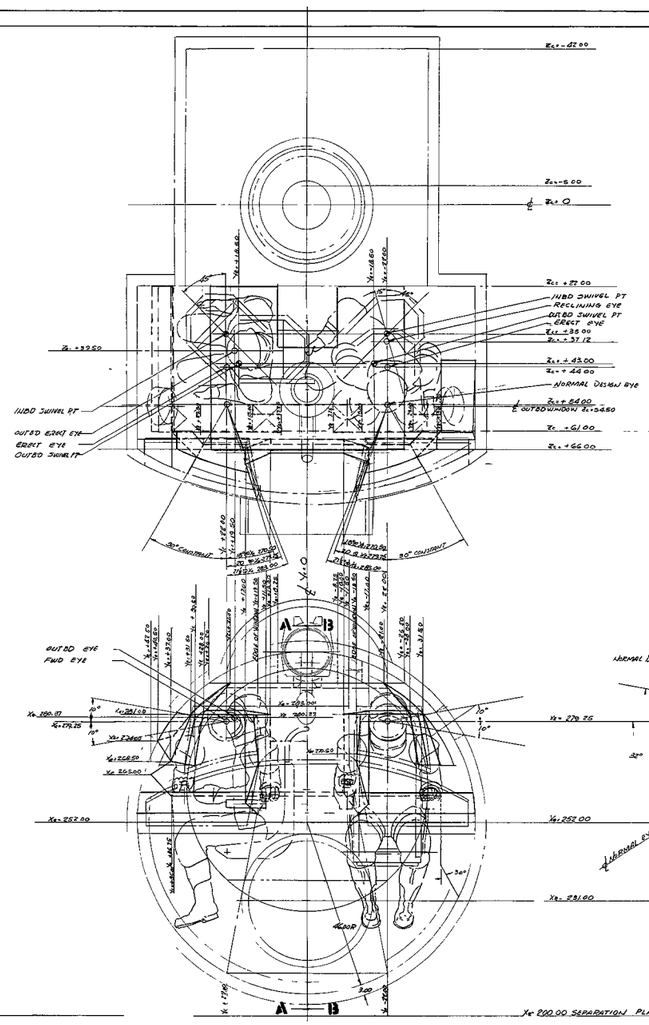

10001-082 MGT
REVISION
ATTITUDE REFERENCE ASM
ALIGNMENT OPTICAL TEL
INERTIAL MEAS. UNIT
RENDEZVOUS ANTENNA (REF)
FUEL (PROP SYS) (REF)
H2 (PROP SYS) (REF)
ELECTRONICS (SIB)
LH2 (ELECT SYS) (REF)
LO2 (ELECT SYS) (REF)
FUEL CELL (REF)
GO2 (ECS) (REF)
WATER STOWAGE (ECS) (REF)
OXIDIZER (RCS) (REF)
OXIDIZER (PROP SYS) (REF)
H2 (RCS) (REF)
FUEL (RCS) (REF)
STA 200 (SEPARATION PLANE)
THRUST
SECTION A-A
OXIDIZER (RCS)
LEM TO EARTH S-BAND ANTENNA (REF)
H2 (RCS)
FUEL (RCS)
WATER STOWAGE (ECS) (REF)
GO2 (ECS)
H2 (PROP SYS) LH2 (ELECT SYS)
ELECTRONICS
FUEL CELLS (3) (ELECT SYS)
LO2 (ELECT SYS)
OXIDIZER (PROP SYS) (REF)
FUEL (PROP SYS) (REF)
LEM TO CM VHF ANTENNA (IN FLIGHT)
RENDEZVOUS ANTENNA
RCS NOZZLE (REF)
LEM TO EARTH S BAND ANTENNA
FUEL (RCS) (REF)
OXIDIZER (RCS) (REF)
H2 (RCS) (REF)
OXIDIZER (PROP SYS)
WATER STOWAGE (ECS) (REF)
THRUST (REF)
VIEW LOOKING AFT
NOTE
1 THIS DWG REPLACES & SUPERSEDES DWG LSK 280-0003 DTD 4/10/69
2 FOR NEXT ASSY USE LDW 280-10000
CONTRACT LINE ITEM NO:
PRIMARY CODE NO 001
REFERENCE PARAGRAPH NO OF EXHIBIT E&S
CATEGORY TYPE III PER EXHIBIT E
GRUMMAN AIRCRAFT ENGRG CORP
BETHPAGE, N.Y.
GENERAL ARRANGMENT
LEM X RSCN STAGE
CONTRACT NO. NAS 9-1000
LDW 280 10001
SCALE 1/10
LDW 280 10001

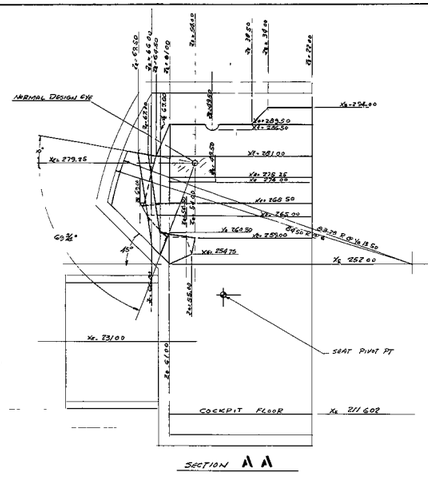

SECT D-D
SECT E-E
SECT C-C
SECT F-F
SECT H-H
SECT A-A
SECT B-B
SECT G-G
SEPARATION PLANE (REF) X 200
SEPARATION PLANE (REF) X 300
EQUIP BAY
COLD BAY FLOOD X 324.40
SEATED FORWARD EYE LOCATION
SEAT PIVOT
COOLANT PLATE (TYP)
FUEL CELL
EYE LOCATION WITH SEAT 10° OUTBOARD
FLOOD X 311.4
① TAPE RECORDER
② INFLIGHT MONITOR ASSY
③ LAUNCH ENGINE
④ STABILIZATION & CONTROL COMPUTER
⑤ RENDEZVOUS RADAR WINDOW
⑥ RENDEZVOUS RADAR
⑦ COMMUNICATIONS 'A' (S BAND WIDE PWR & NARROW DUPLEXER)
⑧ ATTITUDE REF ASSY
⑨ APOLLO GUIDANCE COMPUTER
⑩ VHF/S BAND ANTENNA SWITCHES
⑪ ECED
⑫ ENVIRONMENTAL CONTROL SYST (ECS)
⑬ BACKUP PLATFORM
⑭ DATE SYRO ASSY
⑮ INVERTER
⑯ INVERTER
⑰ AUXILIARY BATTERIES (PROVIDES 2½ HRS EMERGENCY)
⑱ PYRO BATTERIES & RELAY BOX
⑲ COMMUNICATIONS 'B (MODERATE WIDEBAND PWR & NARROW DUPLEX)
⑳ ASCA SCA
㉑ PCMTE
㉒ SIGNAL CONDITIONER
㉓ POWER SERVO ASSY
㉔ JUNCTION BOX
㉕ INERTIAL MEASURING UNIT (IMU)
㉖ RENDEZVOUS RADAR ANTENNA
㉗ ALIGNING OPTICAL TELESCOPE (AOT)
㉘ ECS SUIT CONNECTORS
㉙ CREW PROVISIONS
㉚ OPTICAL SIGHT
㉛ REACTION CONTROL VLVE
㉜ ATITUDE CONTROLLER
㉝ TRANSLATION CONTROLLER
㉞ SERVICE TANK
㉟ LIFE SYSTEM GEN INFLIGHT COMPAR)
㊱ SPACE SUIT REPAIR KIT
㊲ SRC
㊳ BATTERY CHARGER
㊴ PLSS SPARE PARTS
㊵ CAMERA & SCOPE
㊶ ROOMS
㊷ L OH (2)
㊸ L OH (2)
㊹ L OH (2)
㊺ L OH (2)
㊻ TOOLS
㊼ EMERGENCY O2
㊽ THERMAL BARRIERS
GRUMMAN AIRCRAFT ENGINEERING CORP
BETHPAGE, L.I., N.Y.
SIZE
B
CODE IDENT NO
81876
SCALE 1" = 1'
SHEET
GROUP PROFILE
CONVERT COMP BAY - CMP/LM DYNOS
LAUNCH CONFIG
LLO-340-119



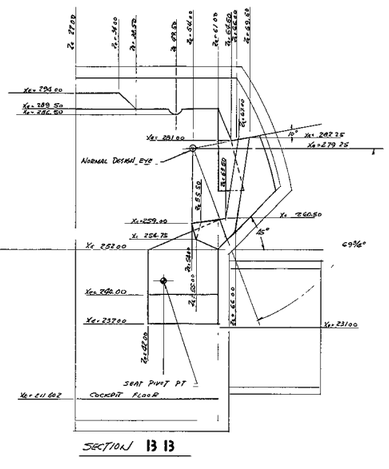
① TAPE RECORDER
② INFLIGHT MAINTEN KITS
③ LANDING RADAR
④ LUNAR MODULE CONTROL COMPUTER
⑤ REMOVABLE RADAR SPACER
⑥ RENDEZVOUS RADAR
⑦ COMMUNICATIONS, C/D ASSEMBLY, PCM AMP DEMOD
⑧ ATTITUDE REF ASSY.
⑨ APOLLO GUIDANCE COMPUTER
⑩ VHF A'S RADIO ANTENNA SWITCHES
⑪ STEP
⑫ ENVIRONMENTAL CONTROL SYSTEM (ELSS)
⑬ BACKUP PLATFORM
⑭ RATE GYRO ASSY
⑮ ACCEL ASSY
⑯ MISSILE
⑰ AUXILIARY BATTERIES (TRANSFER-EMERGENCY)
⑱ PYRO BATTERIES #1&2 IN N/A
⑲ COMMUNICATIONS & DATA SYS UNIT NEAR PNP & NAT BUILT
⑳ ATCA-SCA
㉑ PAINTS
㉒ SIGNAL CONDITIONER
㉓ POWER SERVO ASSY
㉔ ANTENNA
㉕ ASSEMBLY, INSTALLING UNIT ONLY
㉖ RENDEZVOUS RADAR ANTENNA
㉗ ALIGNING OPTICAL TELESCOPE UNIT)
㉘ SCS SUIT DISCONNECTS
㉙ CREW POSITIONS
㉚ OPTICAL SIGHT
㉛ REACTION CONTROL UNIT
㉜ ATTITUDE CONTROLLER
㉝ TRANSLATION CONTROLLER
㉞ LANDING TARGET
㉟ LUNAR MODULE ENVIRON. EQUIPMENT (GENERAL)
㊱ SPACE SUIT REPAIR KIT
㊲ SEAT
㊳ BATTERY CHARGER
㊴ PLSS SPARE PARTS
㊵ CAMERA & MOUNTS
㊶ BOOTS
㊷ LIOH CO
㊸ LIOH CO
㊹ LIOH CO
㊺ LIOH CO
㊻ TOOLS
㊼ EMERGENCY O2
㊽ THERMAL GARMENTS
㊾ LEM TO EARTH S BAND ANTENNA
㊿ LEM TO LM VHF ANTENNA

					GRUMMAN AIRCRAFT ENGINEERING CORP. BETHPAGE, L.I., N.Y.	
					SCALE 1" = 1'-0"	
					DRAWING NO. LLO-540-121	
					SHEET NO. 1 OF 1	

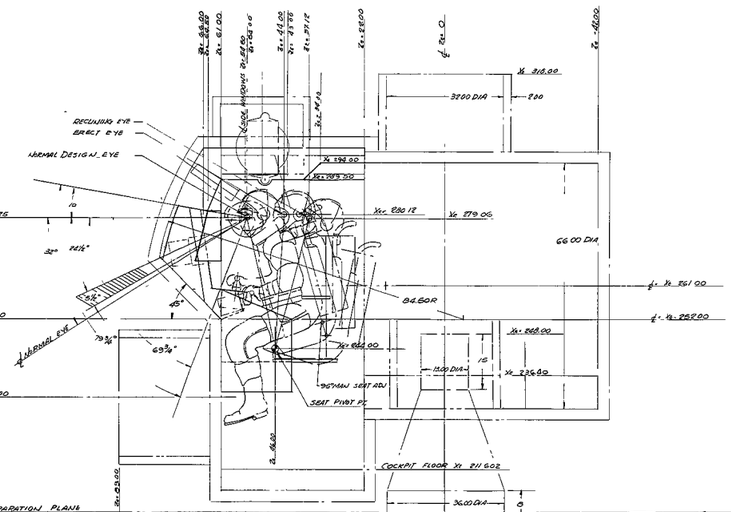




SECTION A A

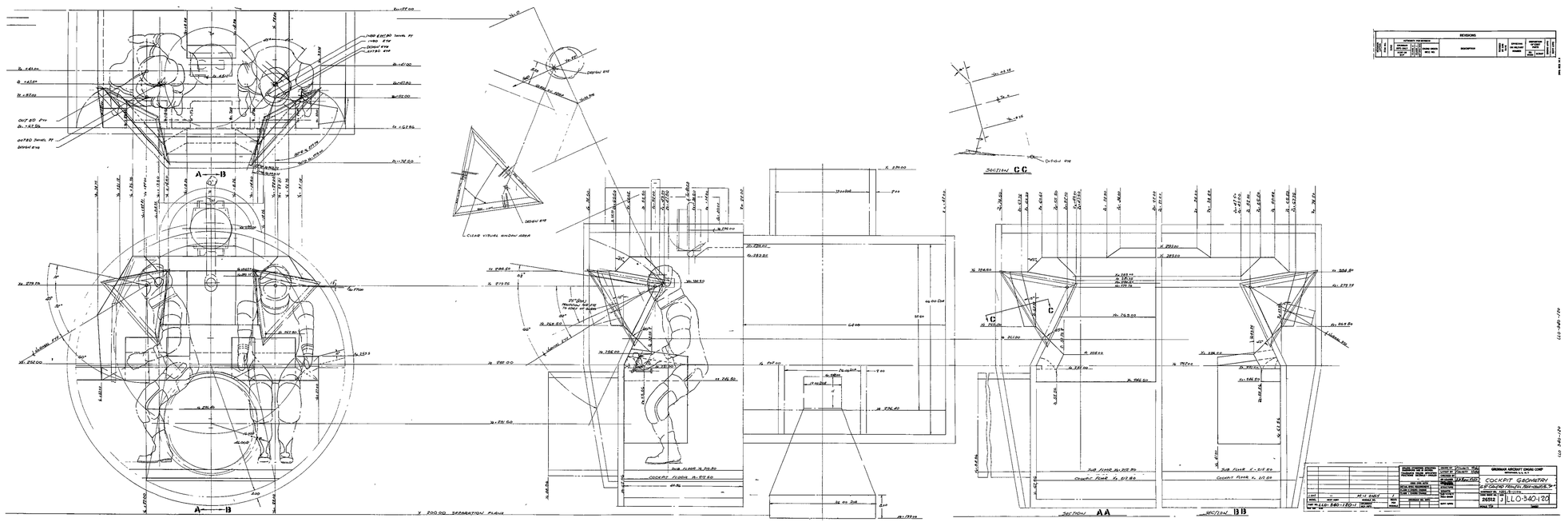


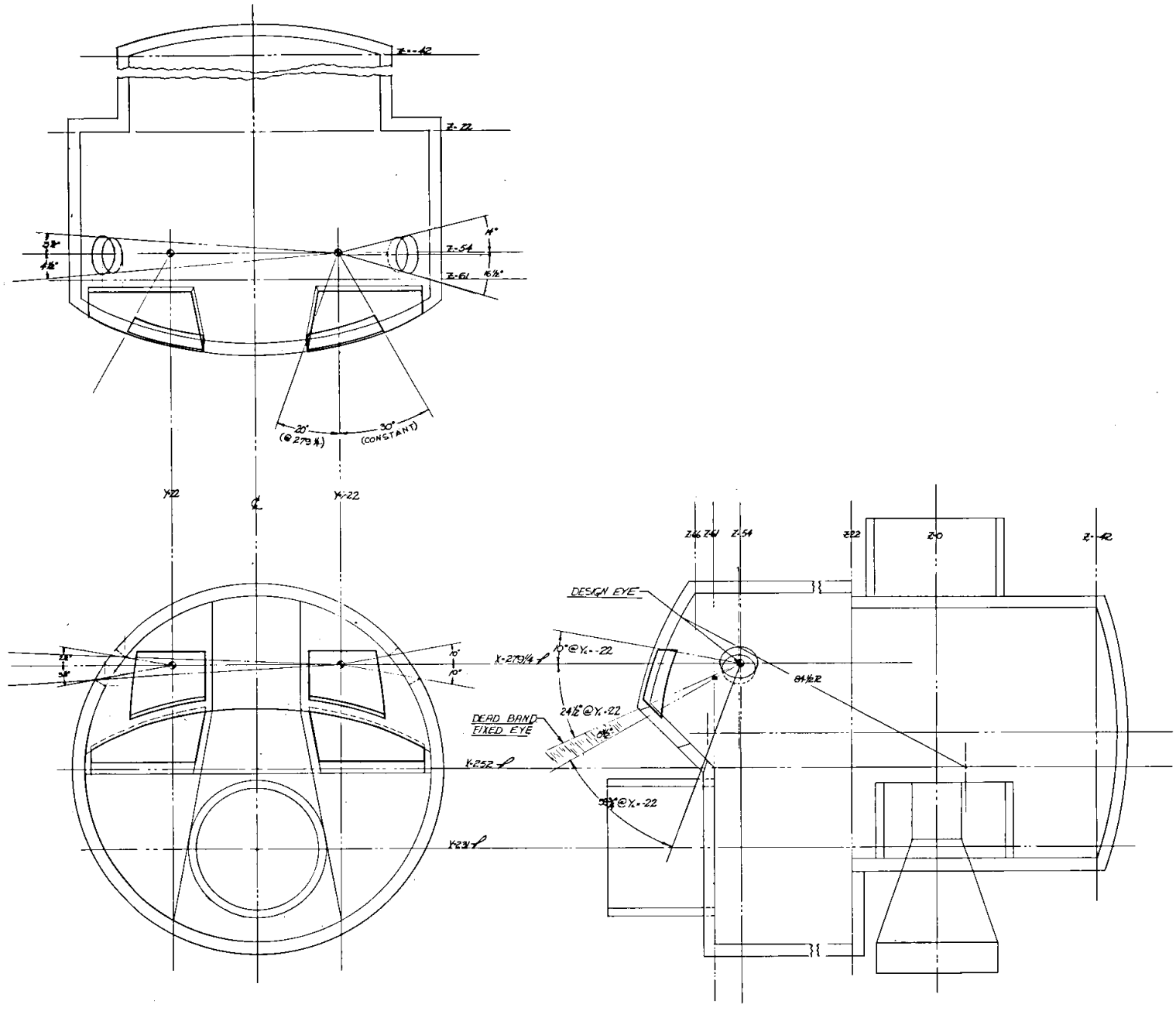
SECTION B B



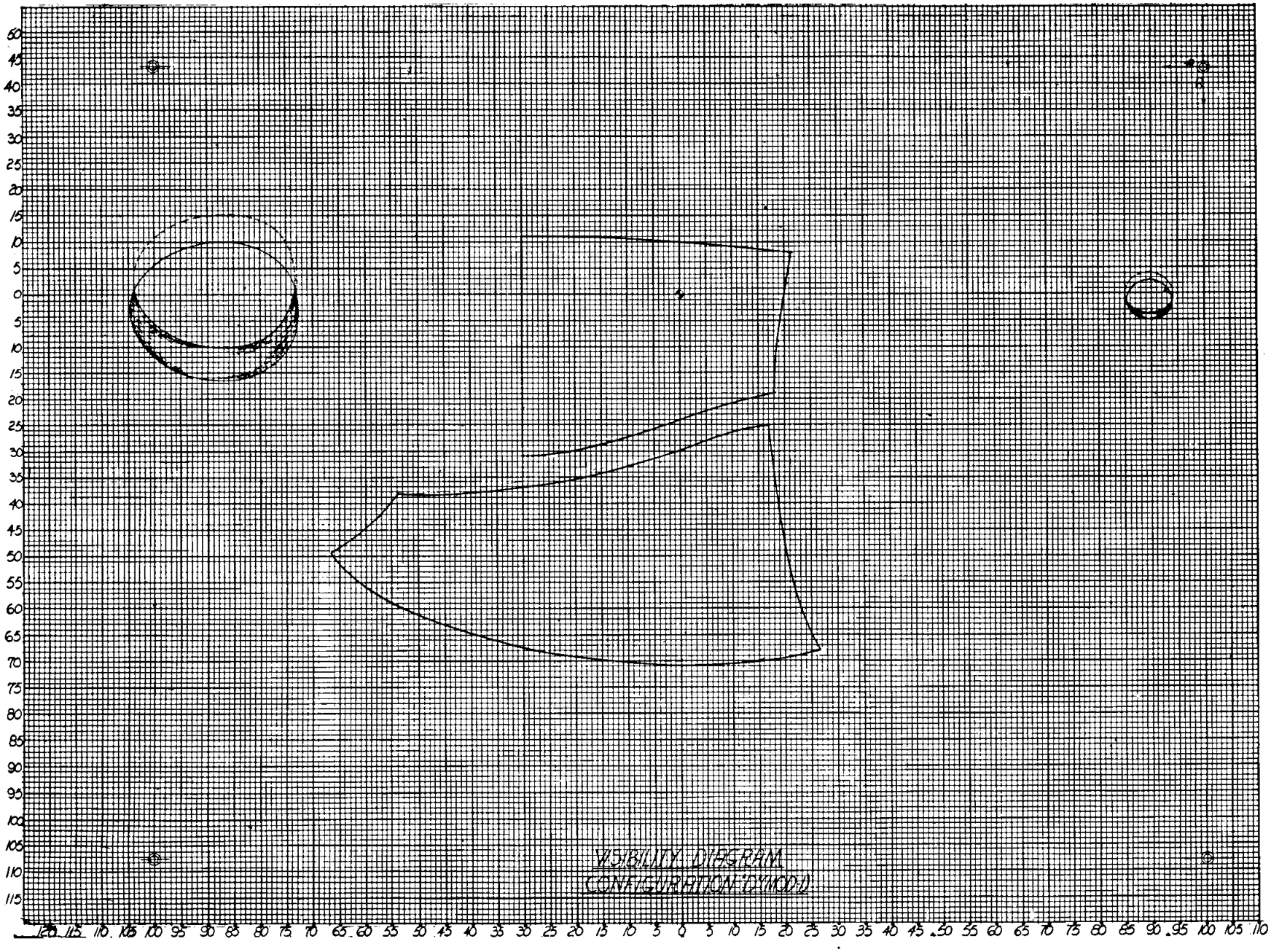
Y= 200.00 SEPARATION PLANE

| | | |

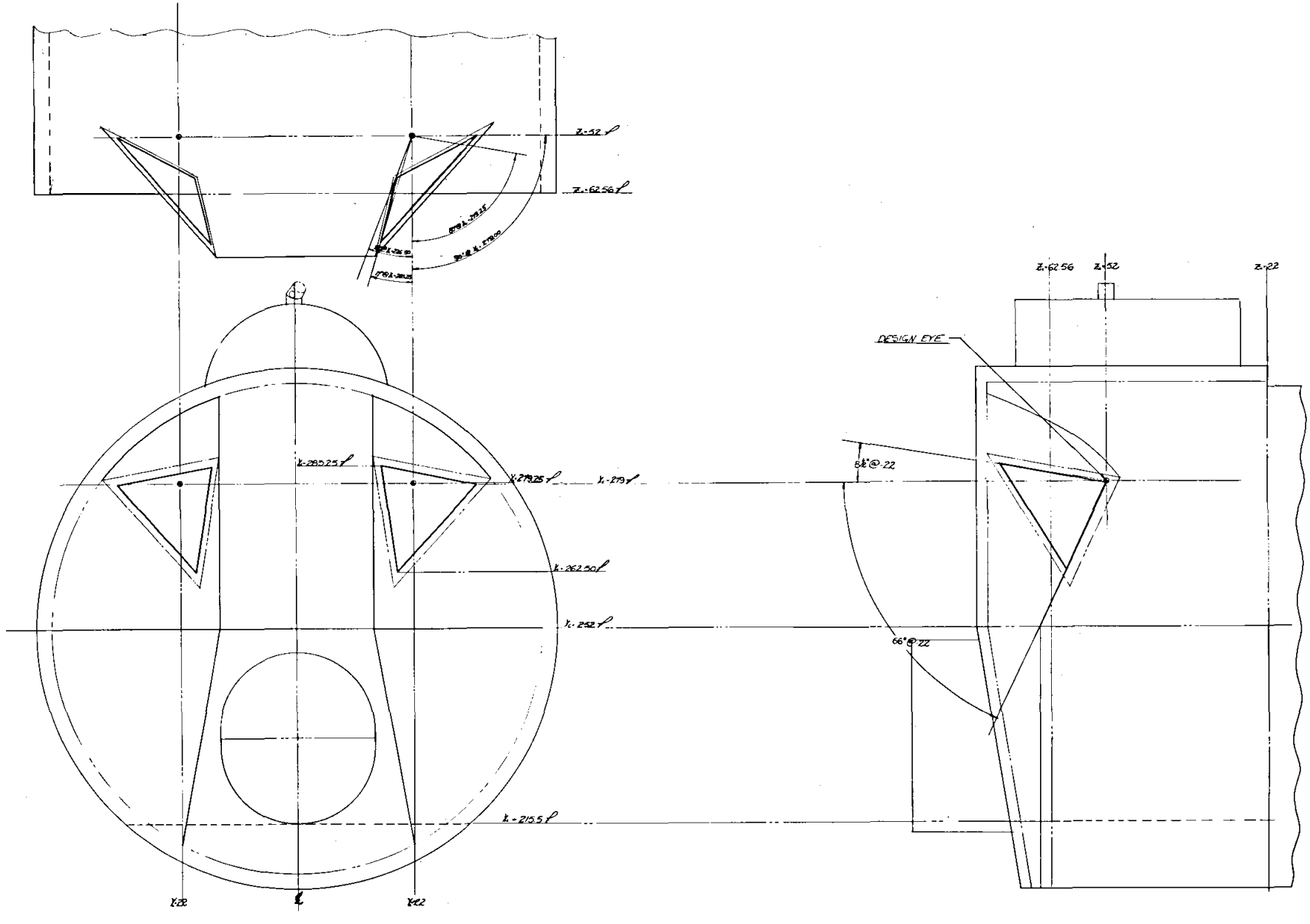

A
B
A
B
SECTION CC
SECTION AA
SECTION BB
Y 200.00 SEPARATION PLANE
CLEAR VISUAL WINDOW AREA
REVISIONS
GRUMMAN AIRCRAFT ENGNG CORP
COCKPIT GROUNDING
& SOUND PANEL INSTALLATION
LLO-340-1201



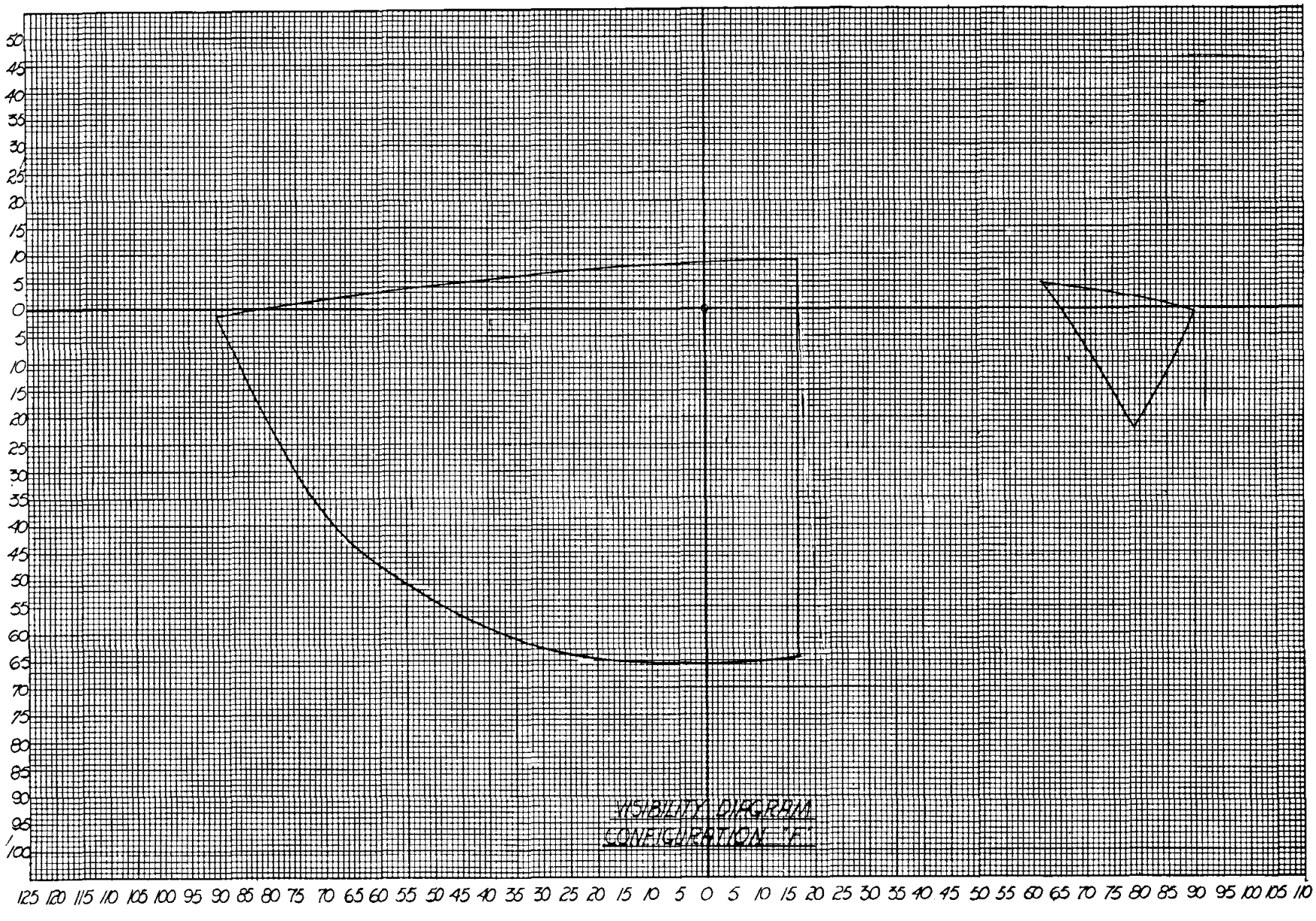
LLO-340-118 Visibility Geometry - Configuration "D" (Mod. -1)



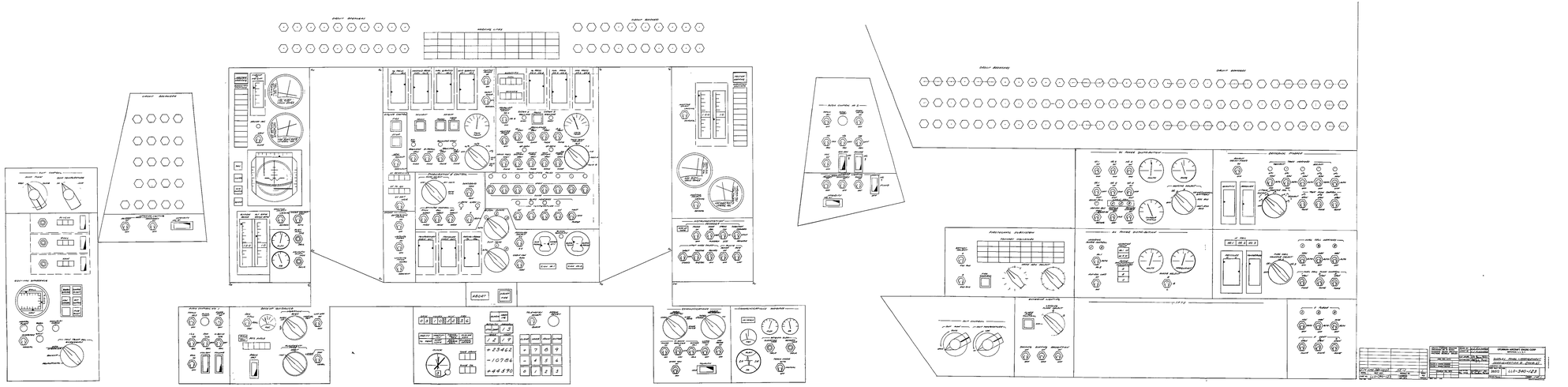
LLO-340-118 Visibility Diagram - Cockpit - Configuration "D"
(Mod. -1)

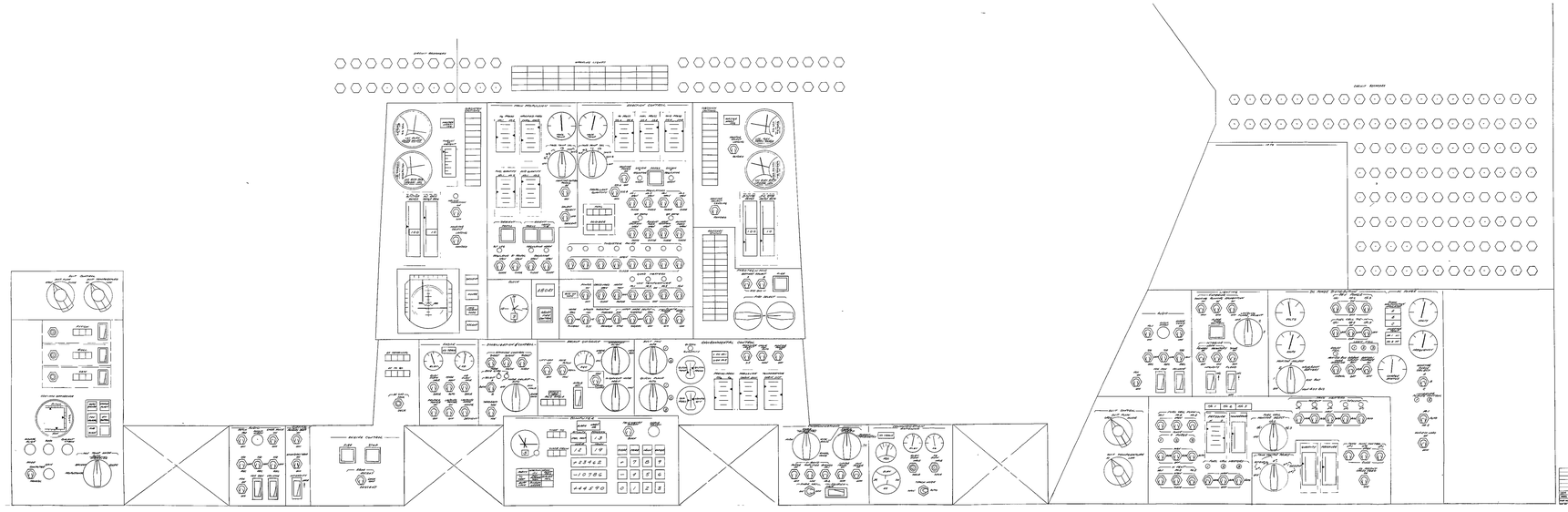


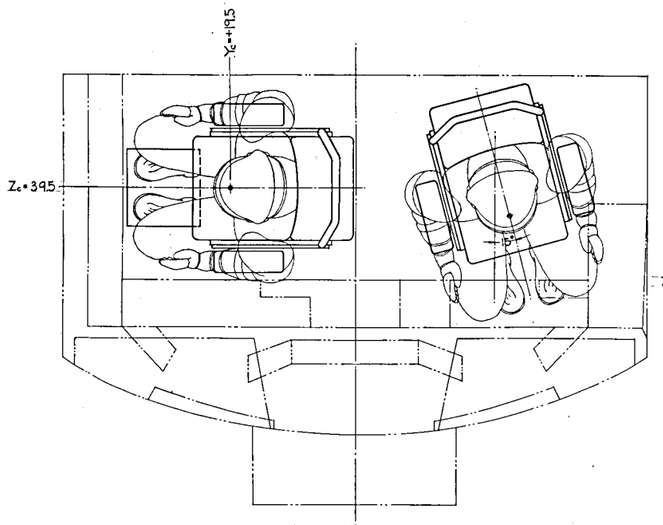
LLO-340-122 Visibility Geometry - Configuration "F"



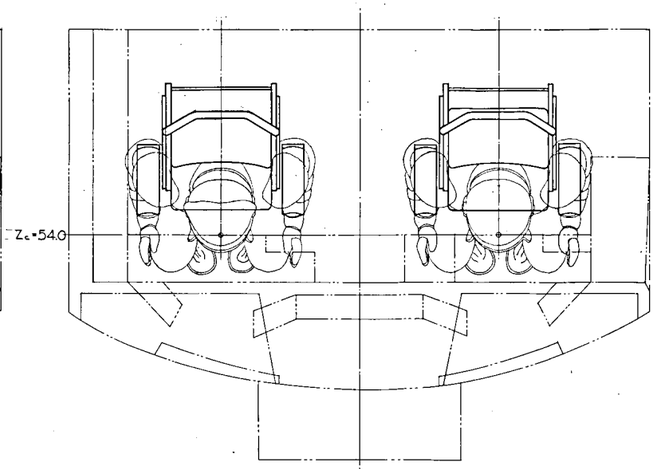
LLO-340-122 Visibility Diagram - Cockpit - Configuration "F"


DRAFT DRAWING
DRAFT DRAWING
DRAFT DRAWING

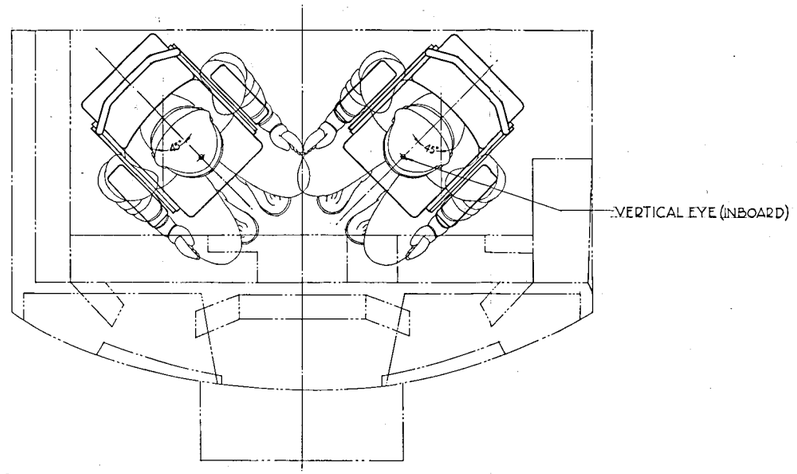

AIRCRAFT NUMBERS
WARNING LIGHTS
NAVIGATION
RADIO CONTROL
ELECTRICAL CONTROL
FUEL
HYDRAULIC CONTROL
ENGINE CONTROL
ENGINE INSTRUMENTS
ENGINE CONTROL
ENGINE INSTRUMENTS
AIRCRAFT NUMBERS
FUEL
ELECTRICAL CONTROL
RADIO CONTROL
NAVIGATION
ENGINE CONTROL
ENGINE INSTRUMENTS



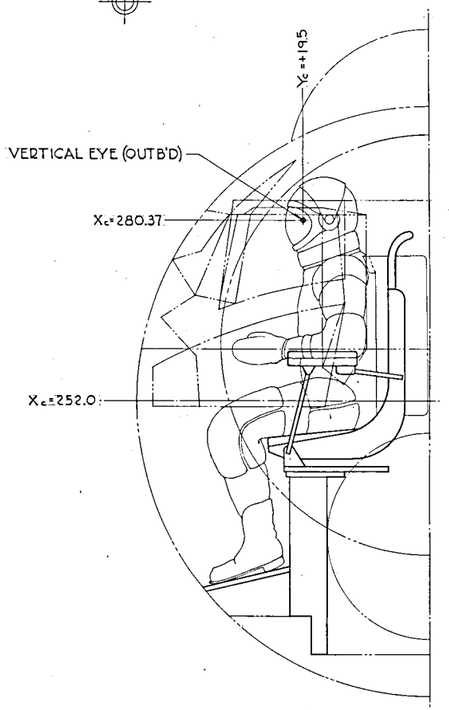
PLAN VIEW
SEATS FACING OUTBD



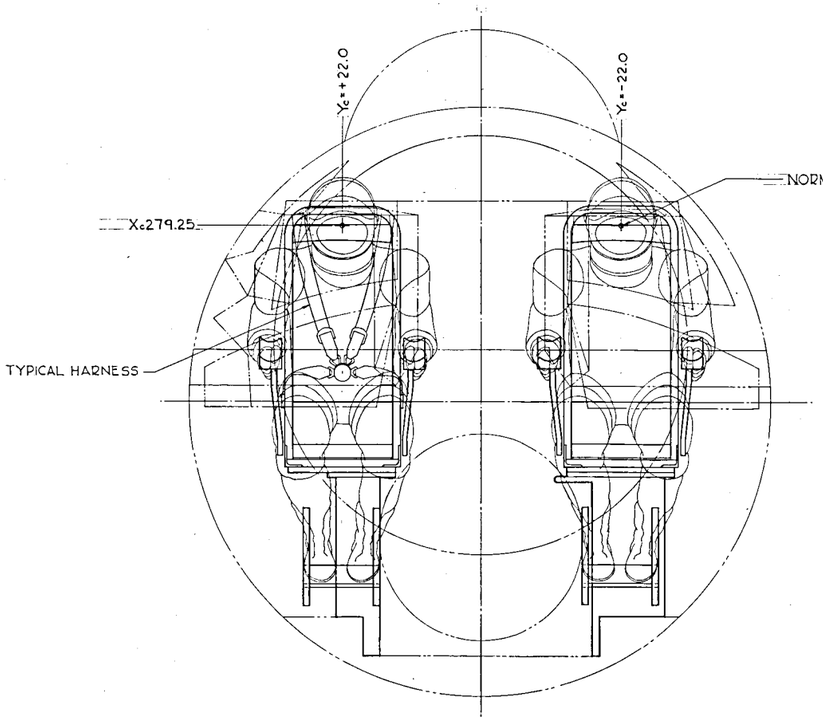
PLAN VIEW
SEATS FACING FWD



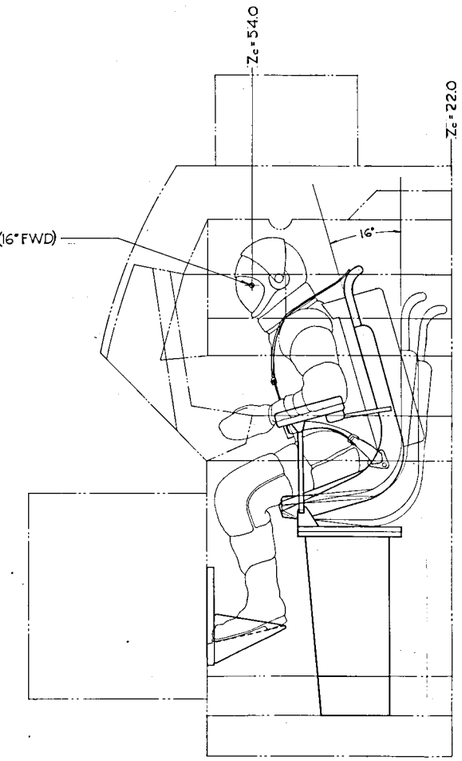
PLAN VIEW
SEATS FACING INBD



HALF-FRONT VIEW



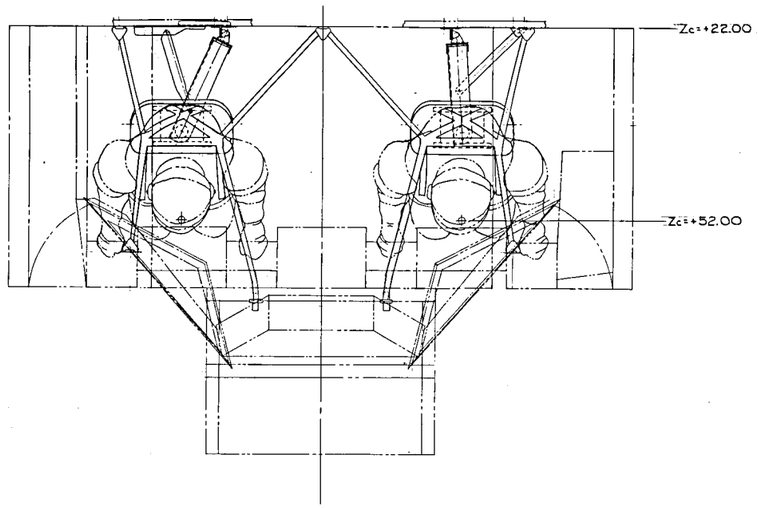
FRONT VIEW

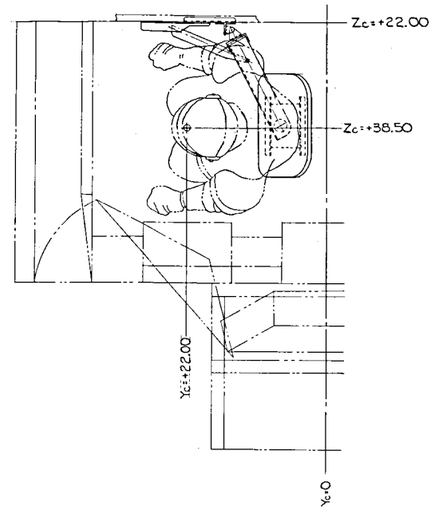


SIDE VIEW

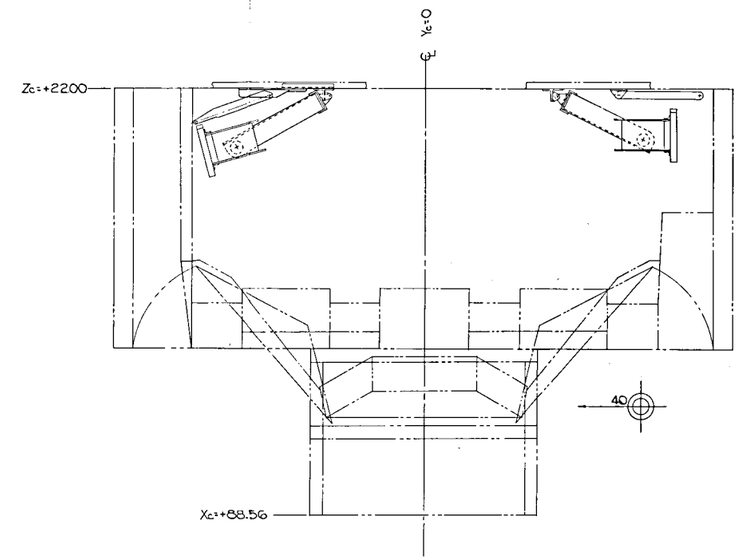
40

LL0340-125

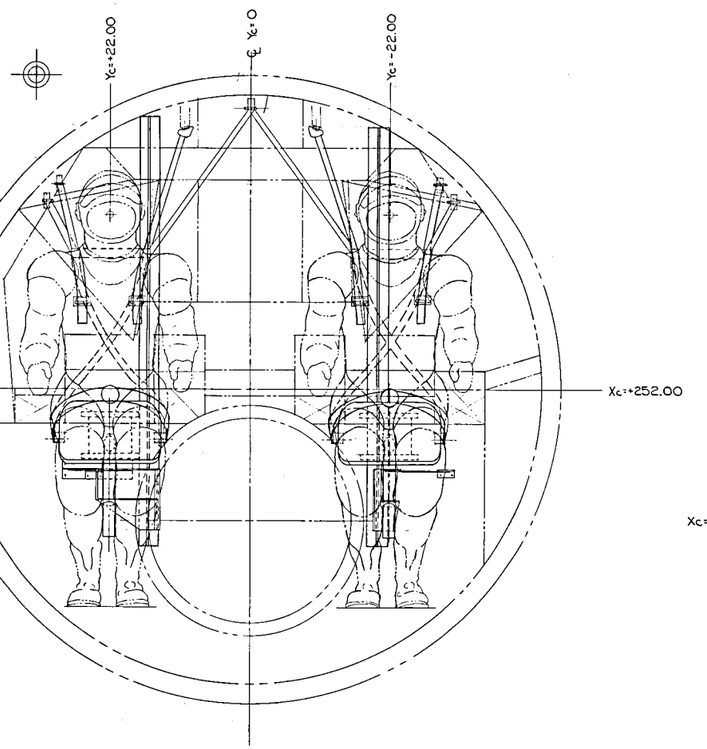


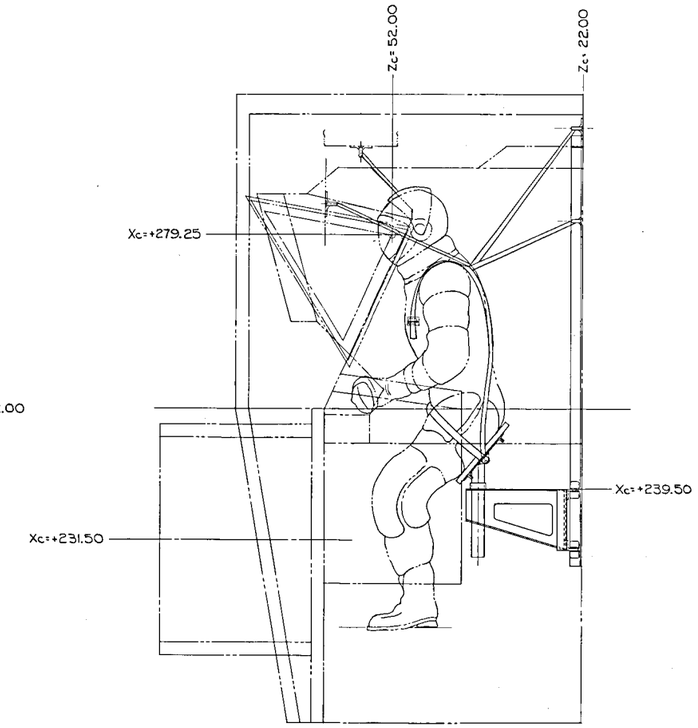


SYSTEMS ENGINEER
ROTATED 90° OUTBD



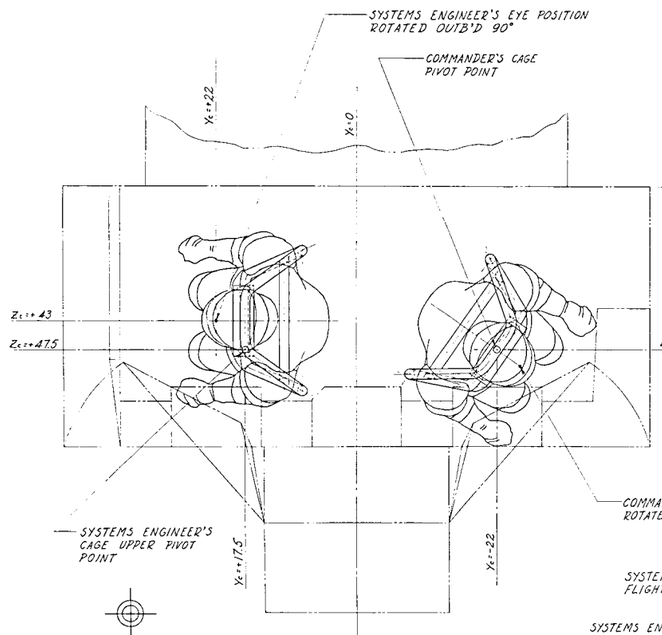
STOWED POSITION



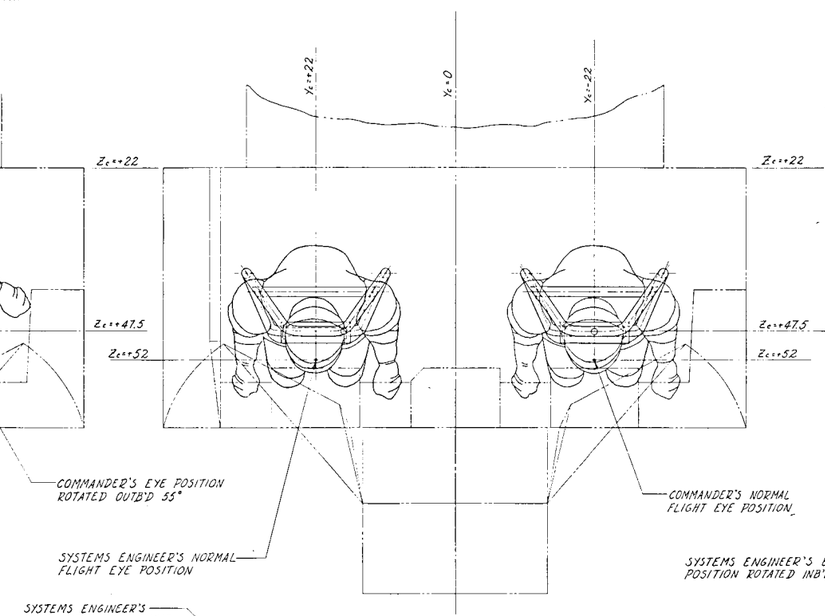


SEATING ARRANGEMENT
BAR STOOL

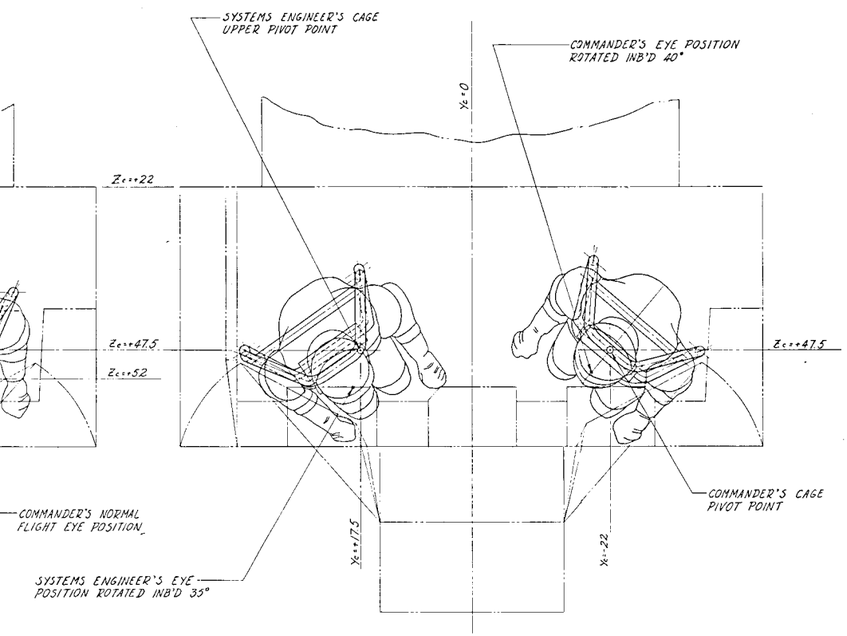
LL0340-126



VIEW SHOWING CAGES ROTATED OUTB'D



PLAN VIEW



VIEW SHOWING CAGES ROTATED INB'D

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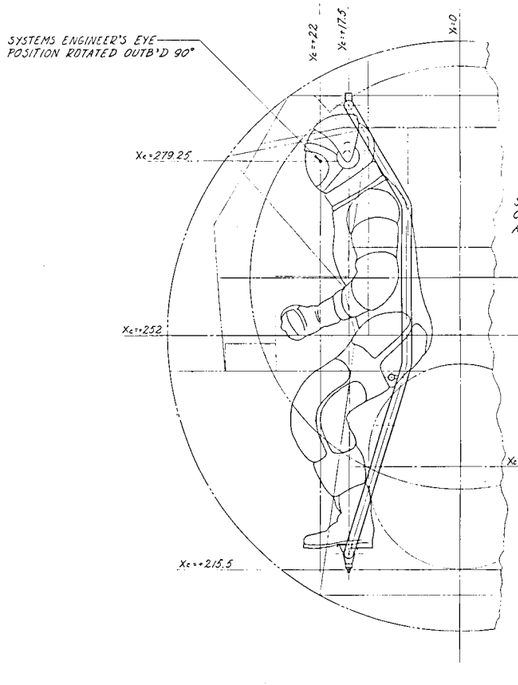
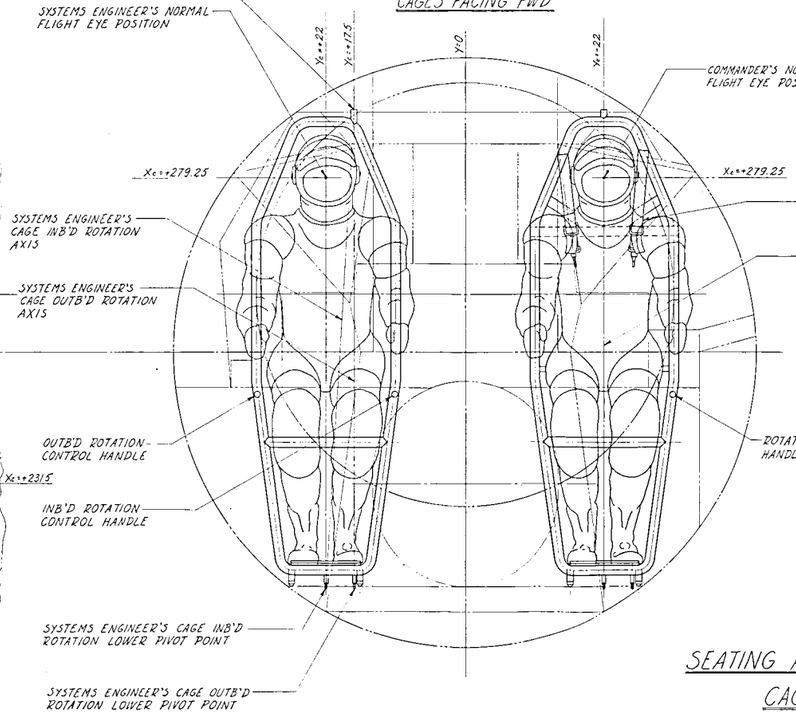
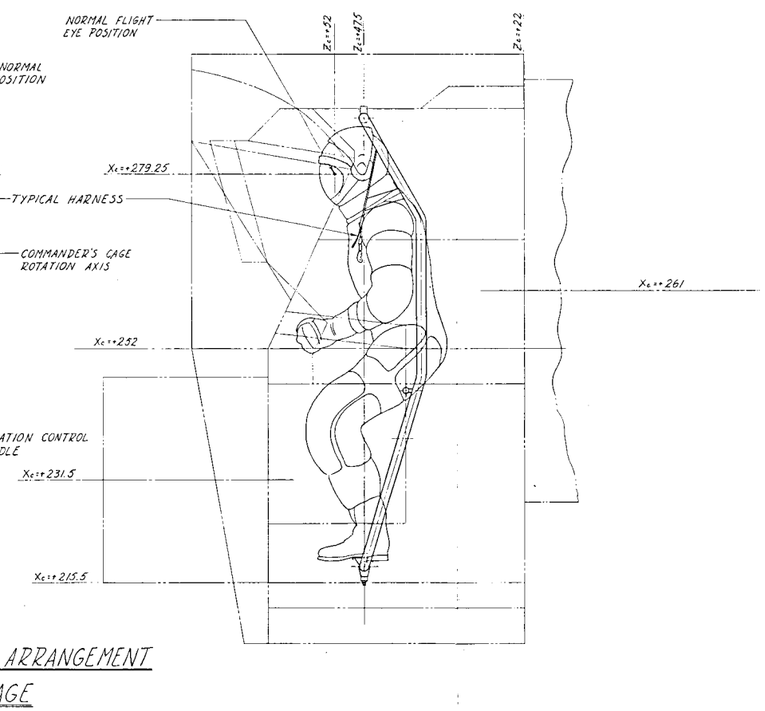


VIEW SHOWING CAGES ROTATED OUTB'D



PLAN VIEW
CAGES FACING FWD



VIEW SHOWING CAGES ROTATED INB'D

SEATING ARRANGEMENT
CAGE

LL0340-127

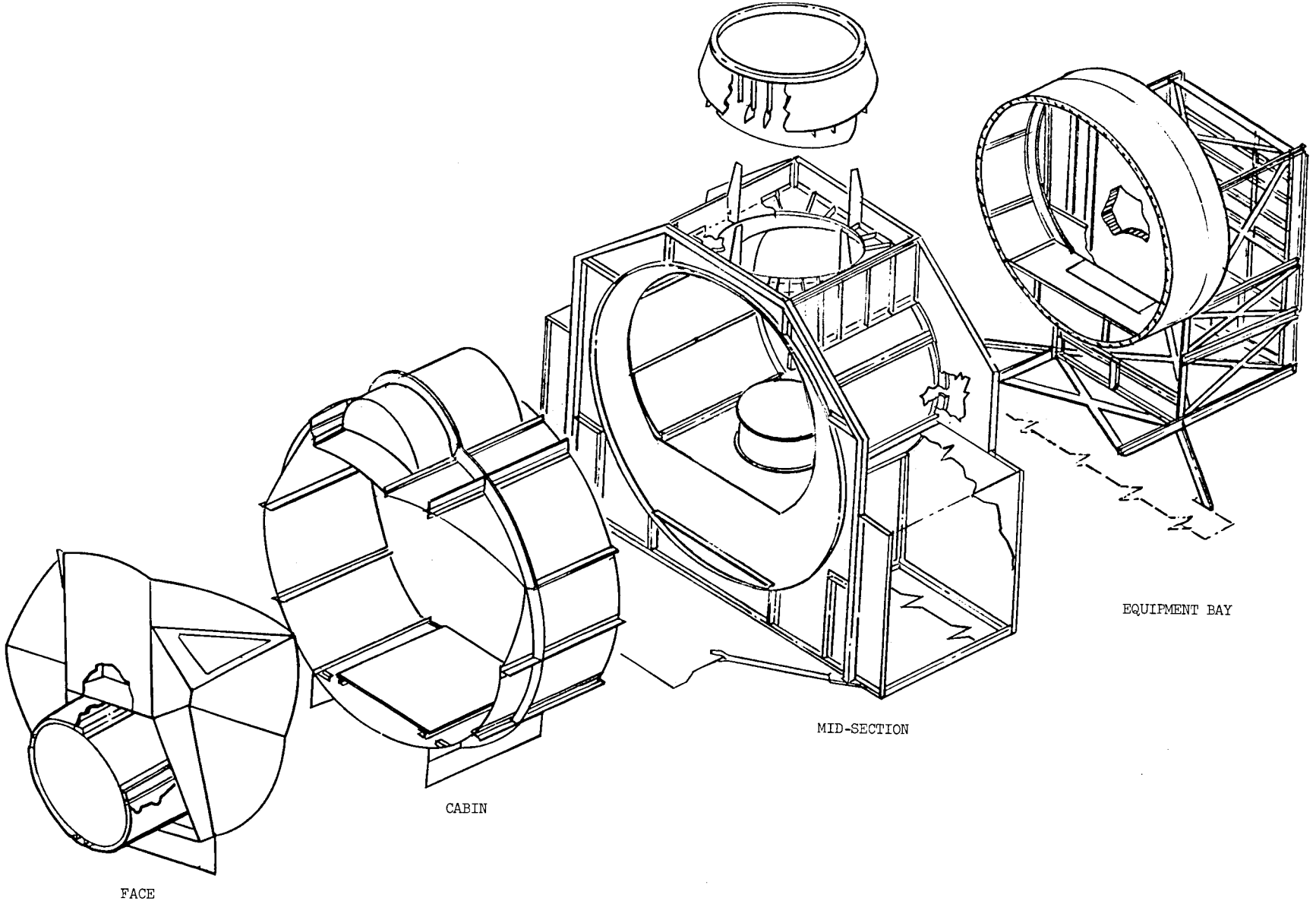


Chart Structural Arrangement - Ascent Stage

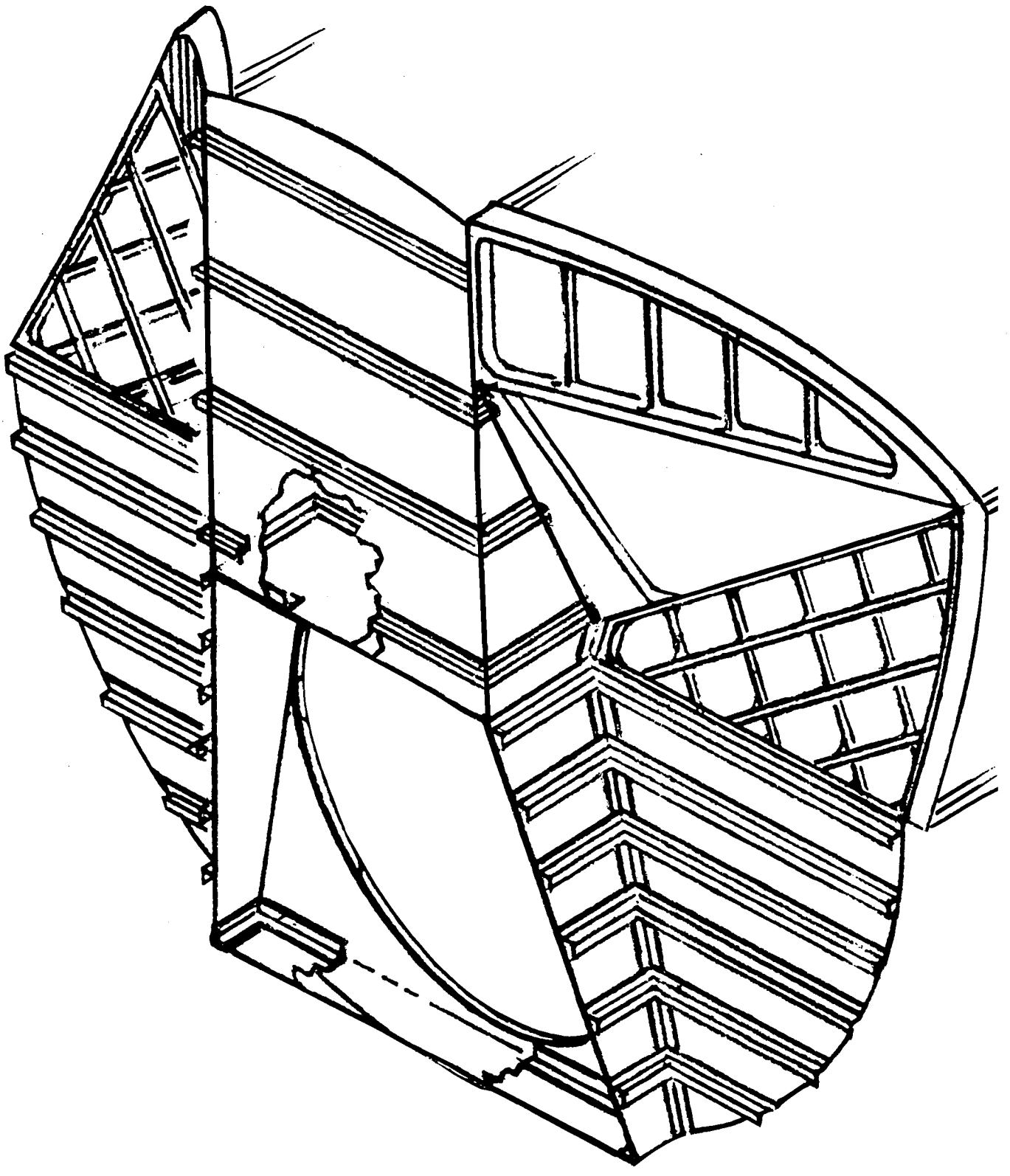
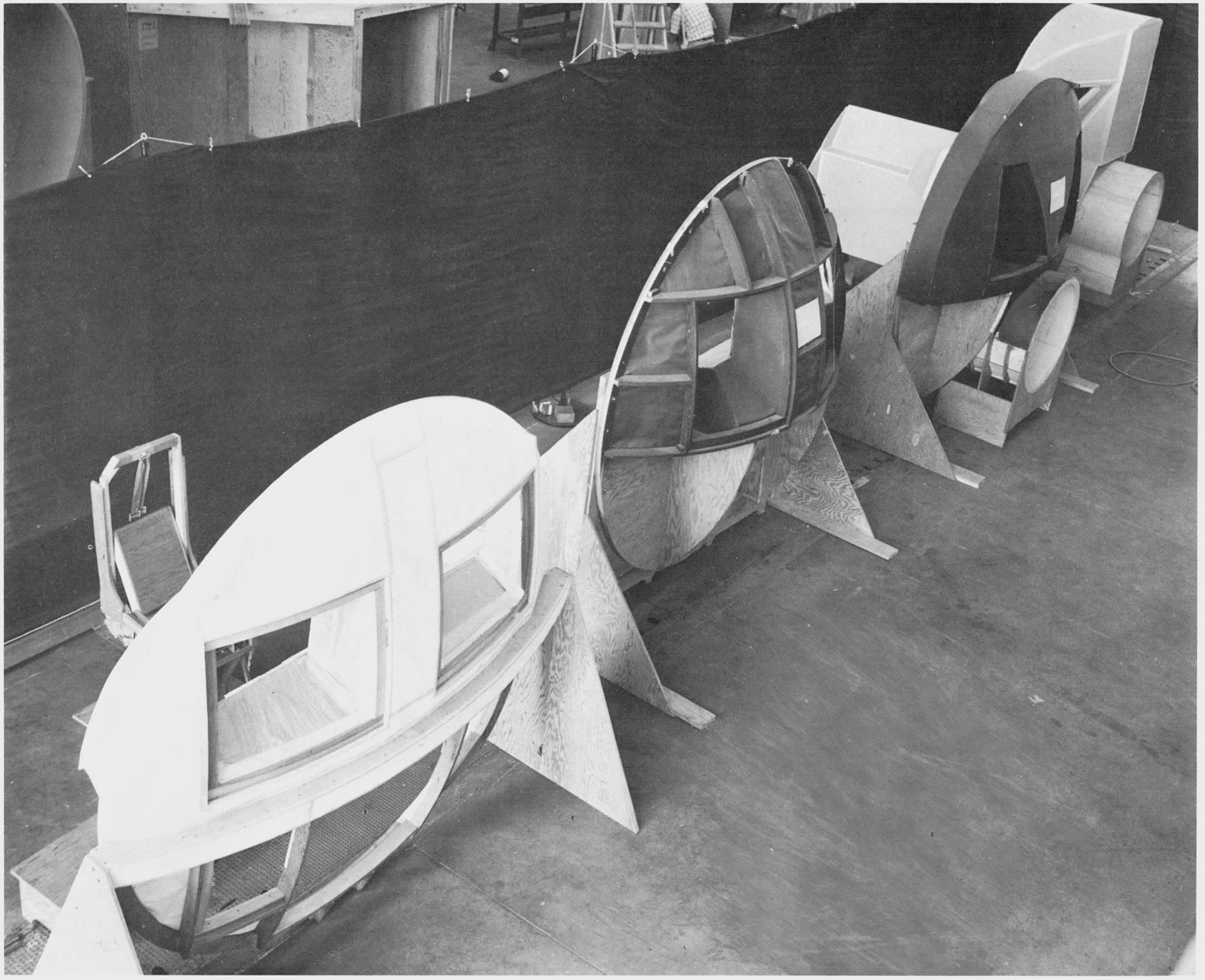


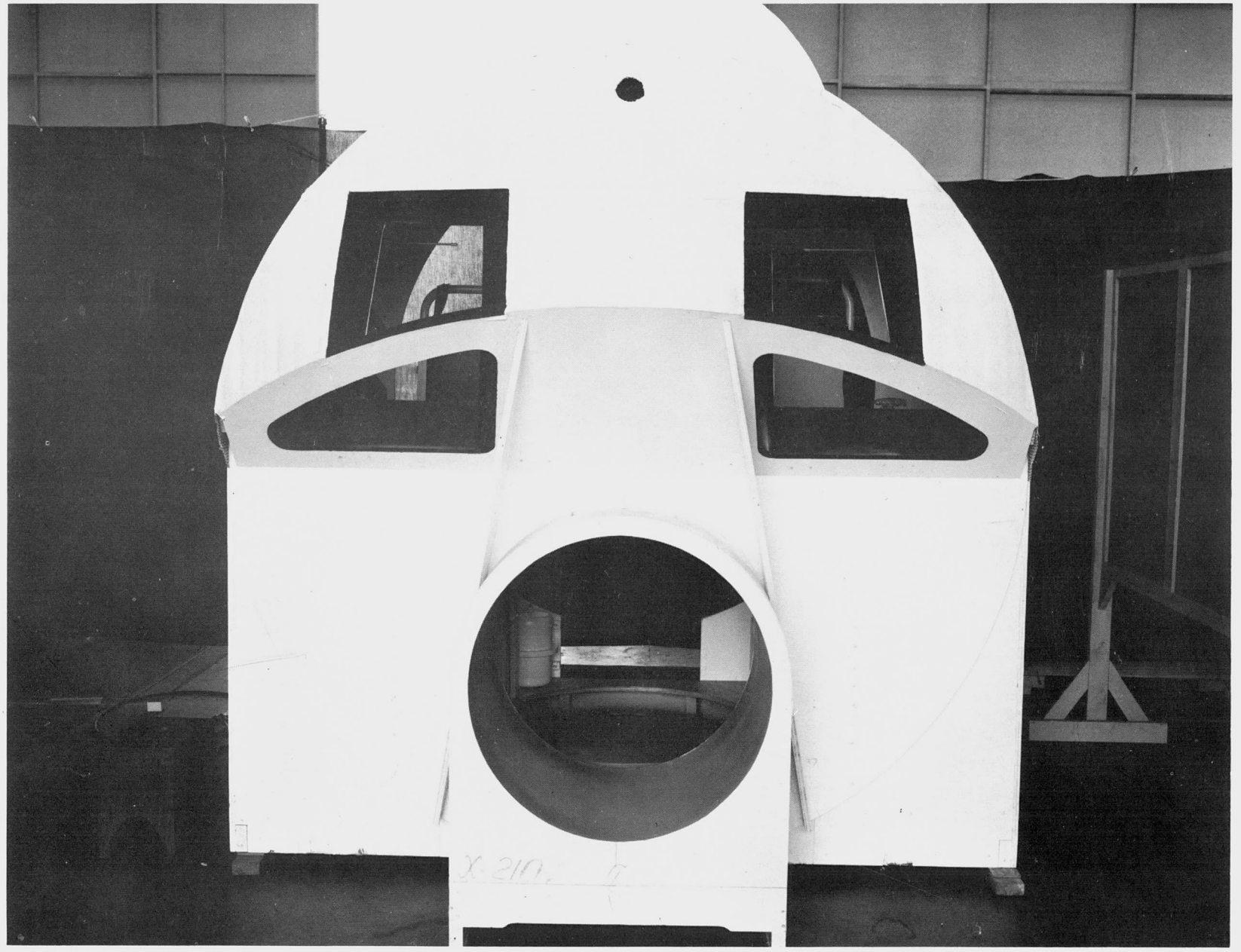
Chart Structural Arrangement - Cabin Face

VII. PHOTOS

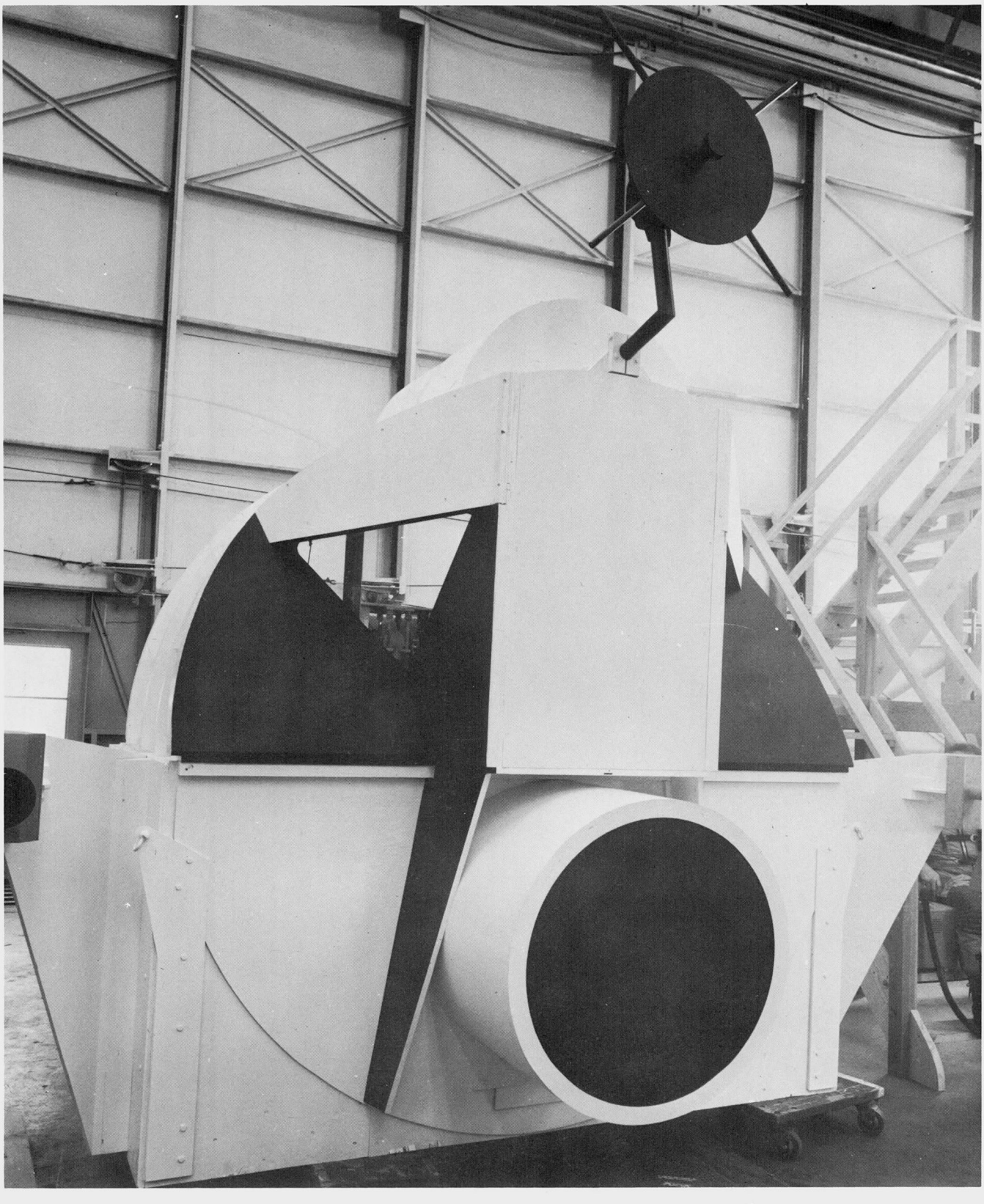
LPH-340-162	View Showing Frontal Face Studies - Configurations "B", "C", "E", & Original "F"
LPH-340-163	View Showing External Shape of Frontal Face Study Configuration "D" (Mod. -1)
LPH-340-164	View Showing Cockpit Arrangement of Configuration "D" (Mod. -1)
LPH-340-165	View Showing External Shape of Frontal Face Study Configuration "F"
LPH-340-166	View Showing Cockpit Arrangement of Configuration "F"
LPH-340-167	View Showing Bar Stool Installation - Normal Position
LPH-340-168	View Showing Bar Stool Installation - Rotated Position
LPH-340-169	View Showing Cage Installation - Normal Position
LPH-340-170	View Showing Cage Installation - Rotated Positions
LPH-340-171	View Showing Equipment Tunnel - Upper Hatch Closed
LPH-340-172	View Showing Equipment Tunnel - Upper Hatch Opened
LPH-340-173	View Showing M-1 Mock-Up Halves Mated
LPH-340-174	View Showing Lunar Surface as Viewed From 1000 ft. of altitude
LPH-340-175	View Showing Installation of IMU, AOT and BGP in Overhead Section of Cockpit
LPH-340-176	View Showing 1/6th Gravity Demonstrator (Peter Pan Sr.)
LPH-340-177	View Showing 1/6th Gravity Demonstrator (Peter Pan Jr.)



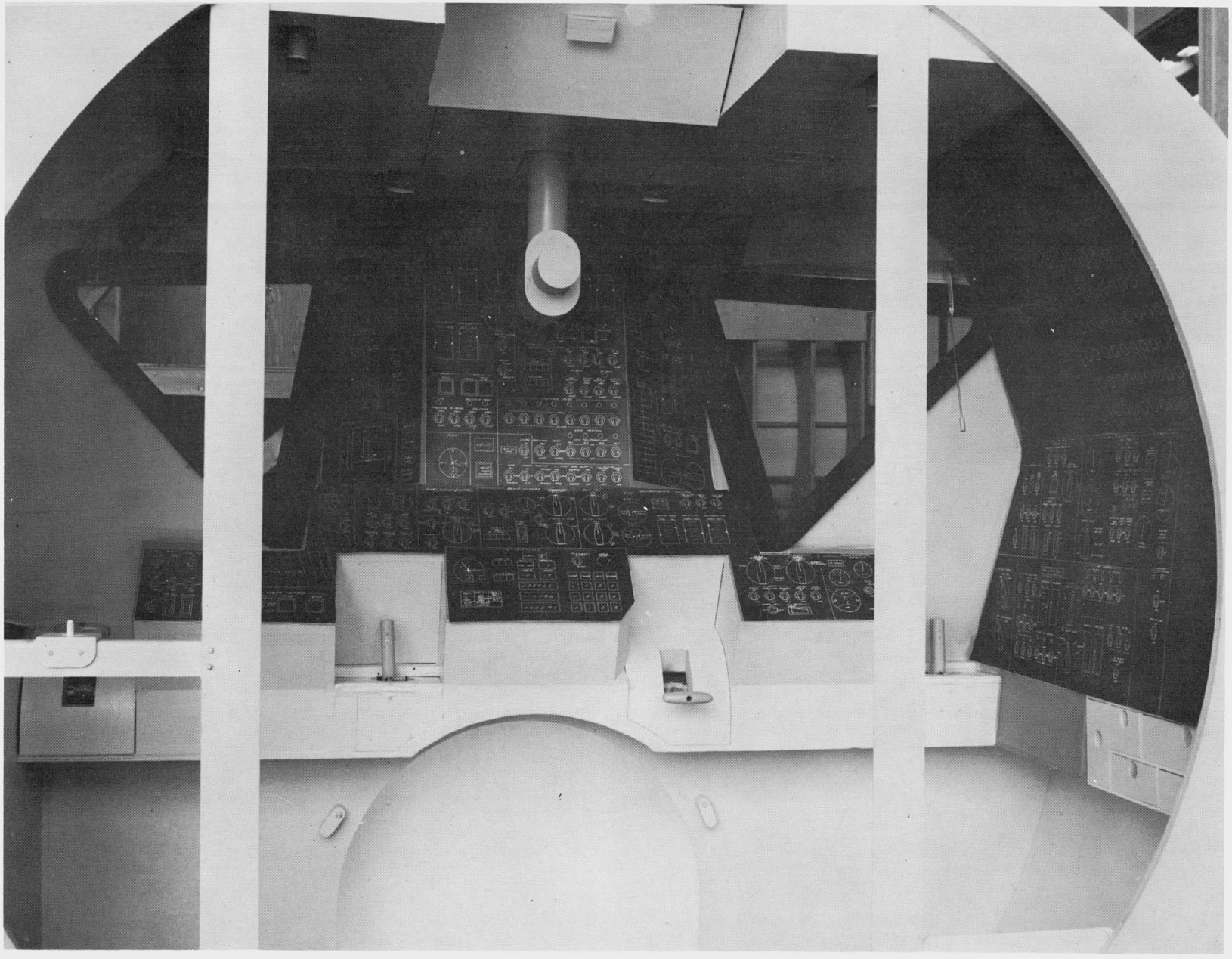
LPH-340-162 View Showing Frontal Face Studies- Configurations "B," "C," "E," and Original "F"



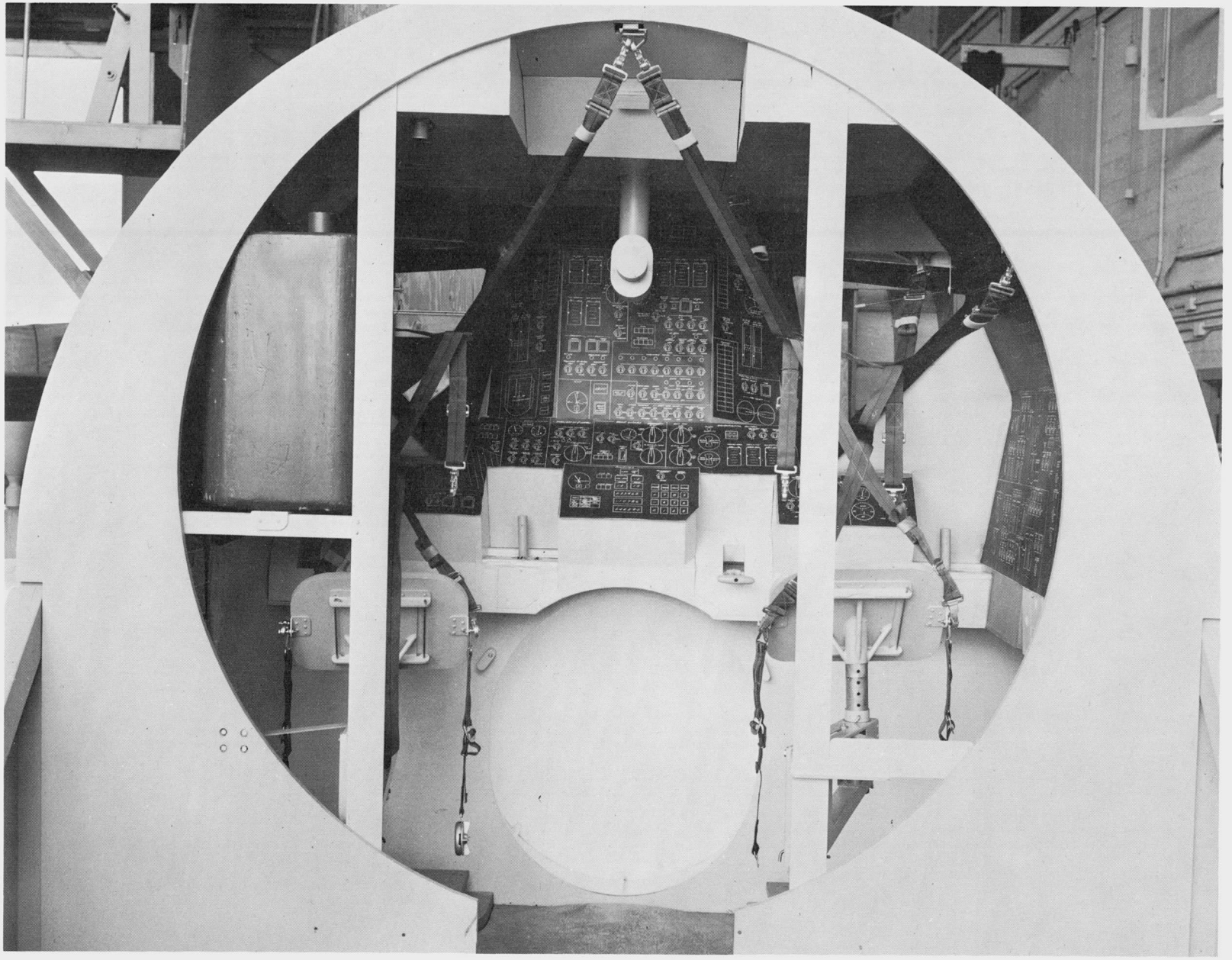
LPH-340-163 View Showing External Shape of Frontal Face Study Configuration "D" (Mod. -1)



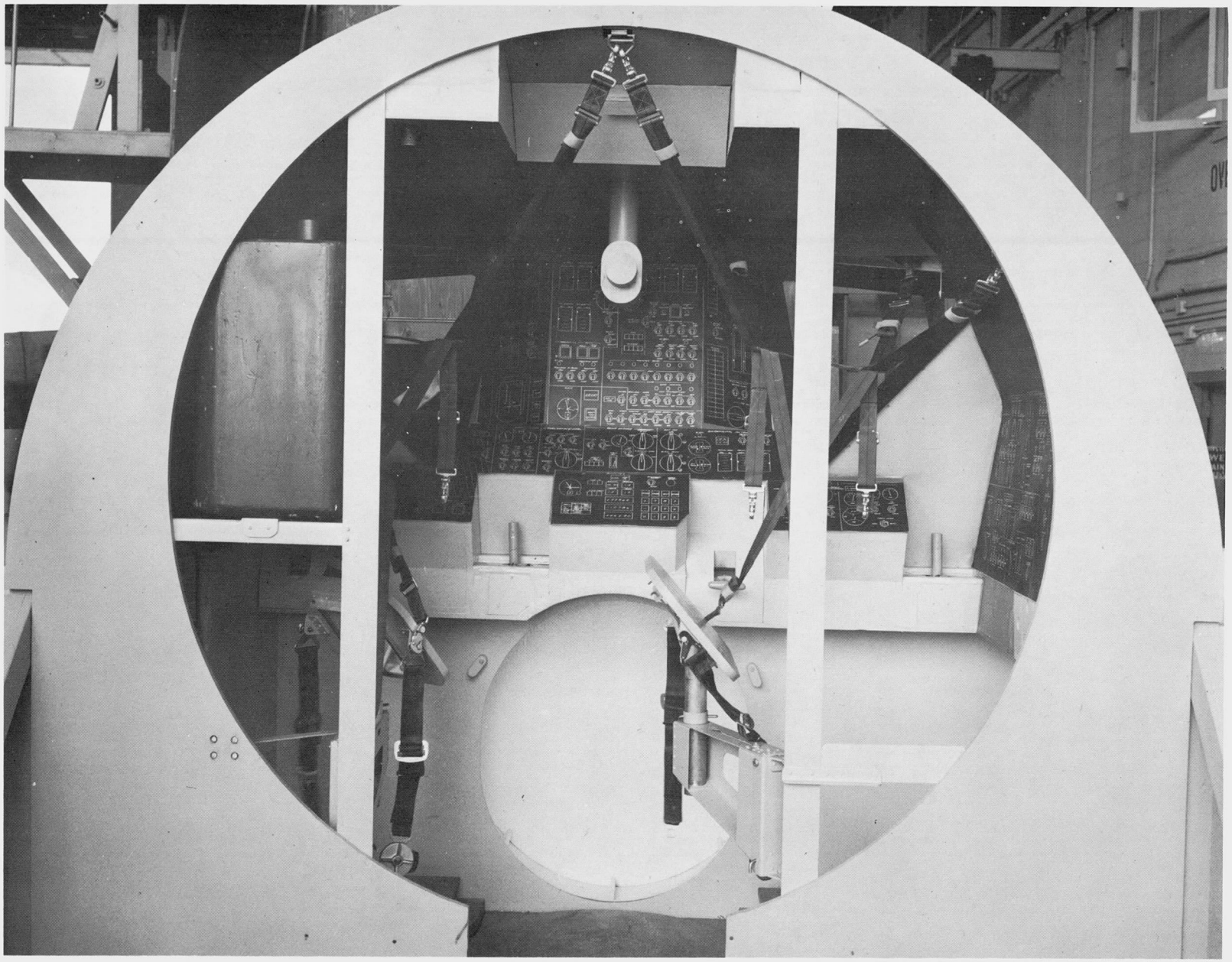
LPH-340-165 View Showing External Shape of Frontal Face Study Configuration "F"



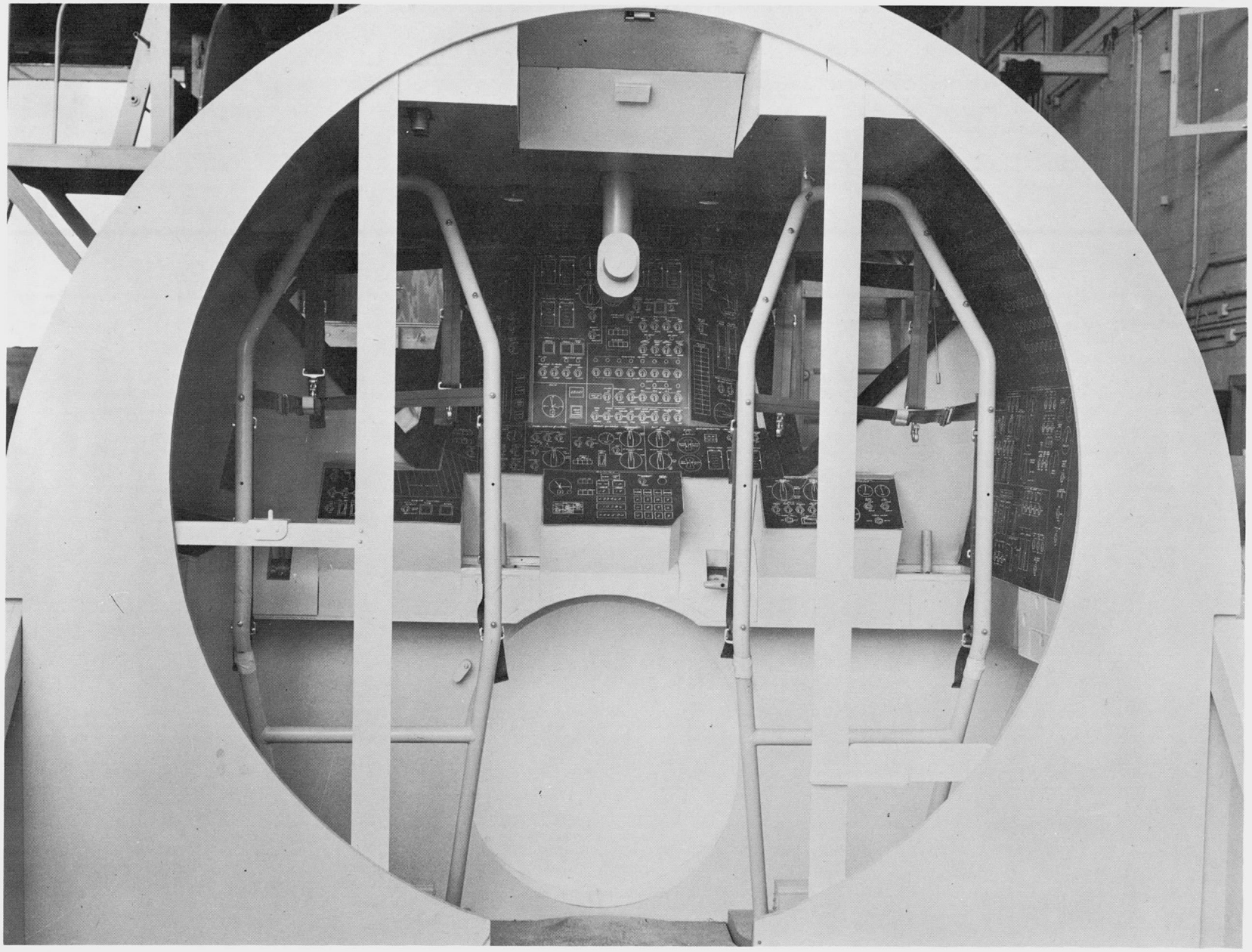
LPH-340-166 View Showing Cockpit Arrangement of Configuration "F"



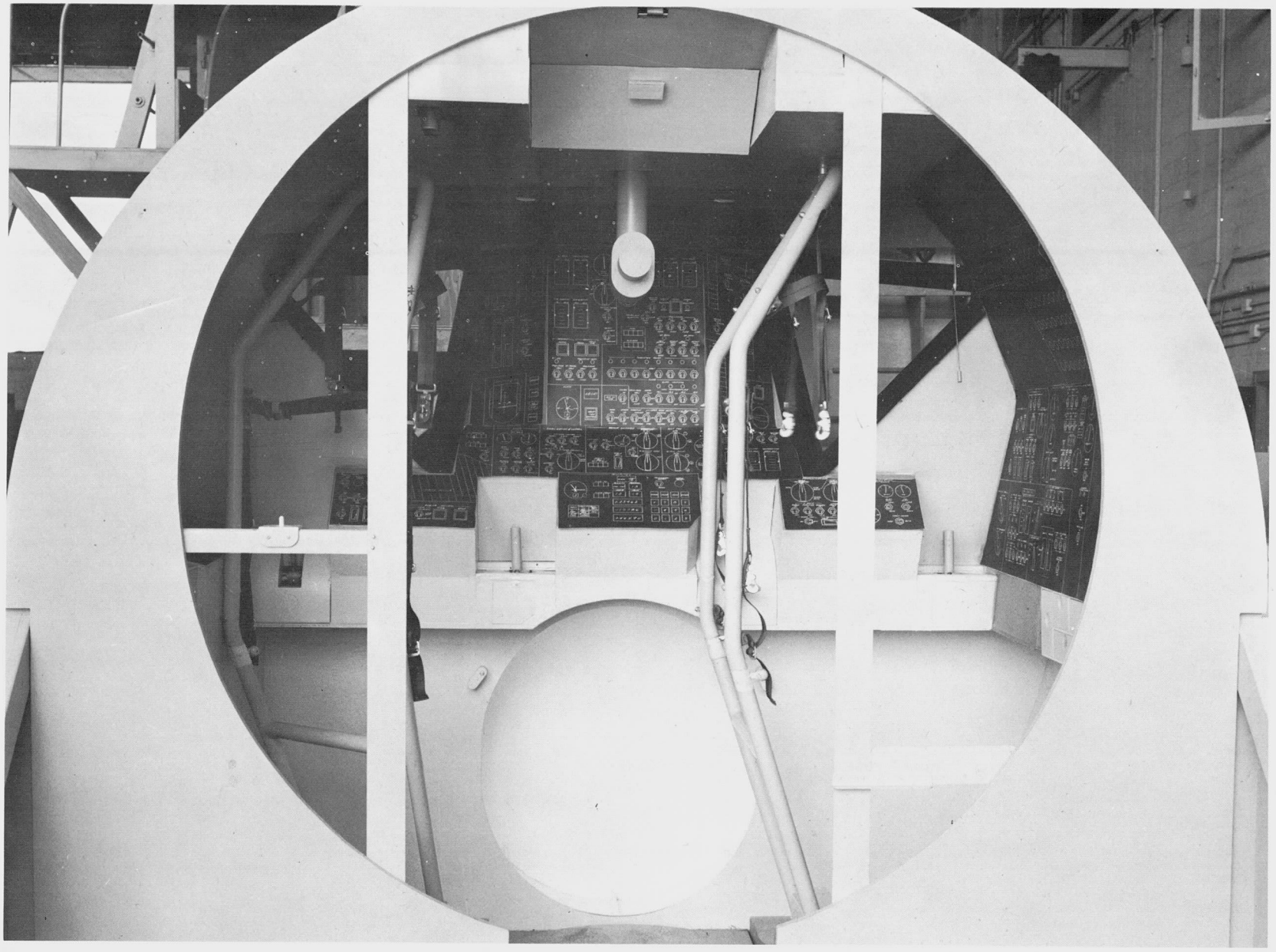
LPH-340-167 View Showing Bar Stool Installation - Normal Position



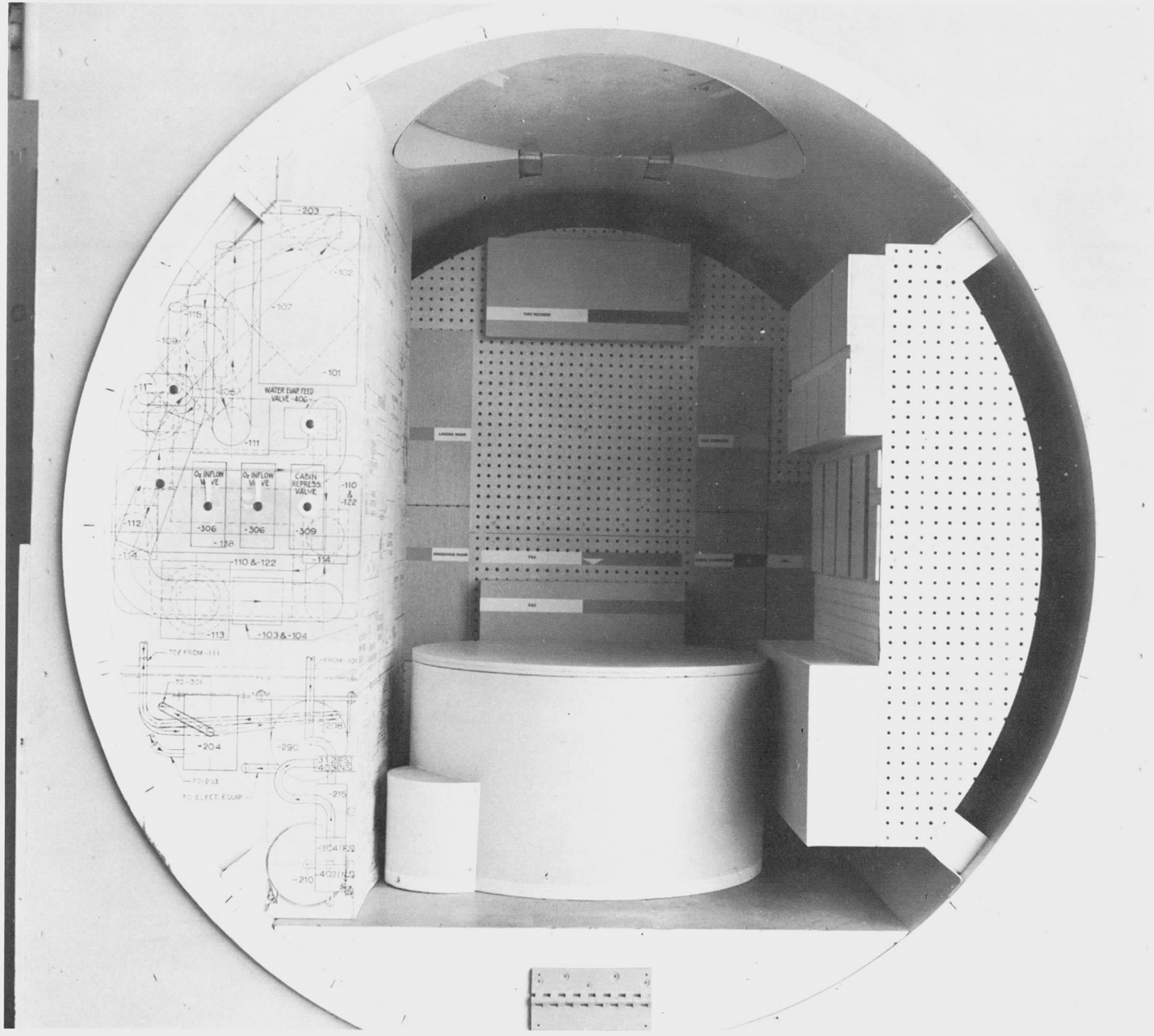
LPH-340-168 View Showing Bar Stool Installation - Rotated Position



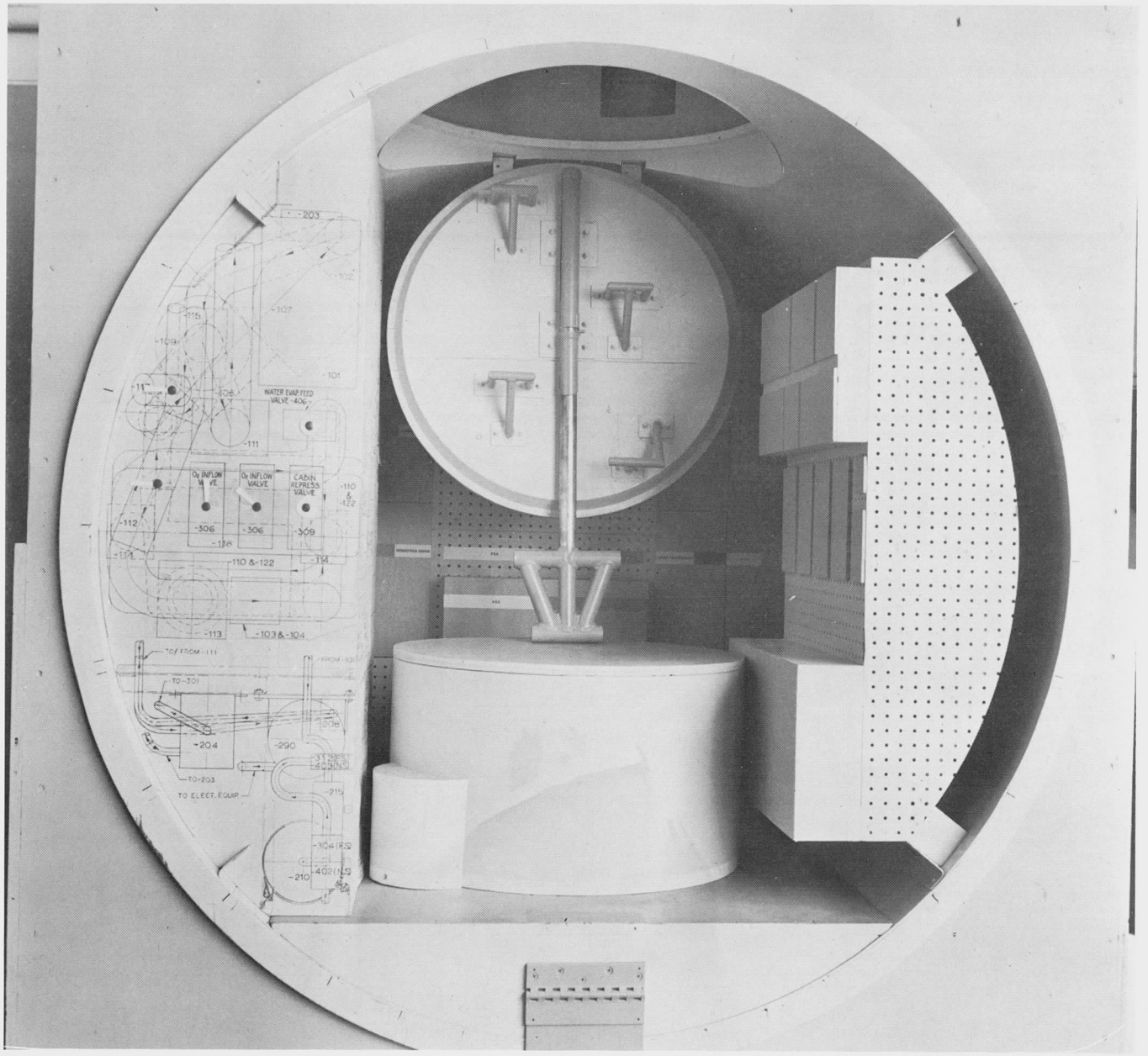
LPH-340-169 View Showing Cage Installation - Normal Position



LPH-340-170 View Showing Cage Installation - Rotated Positions

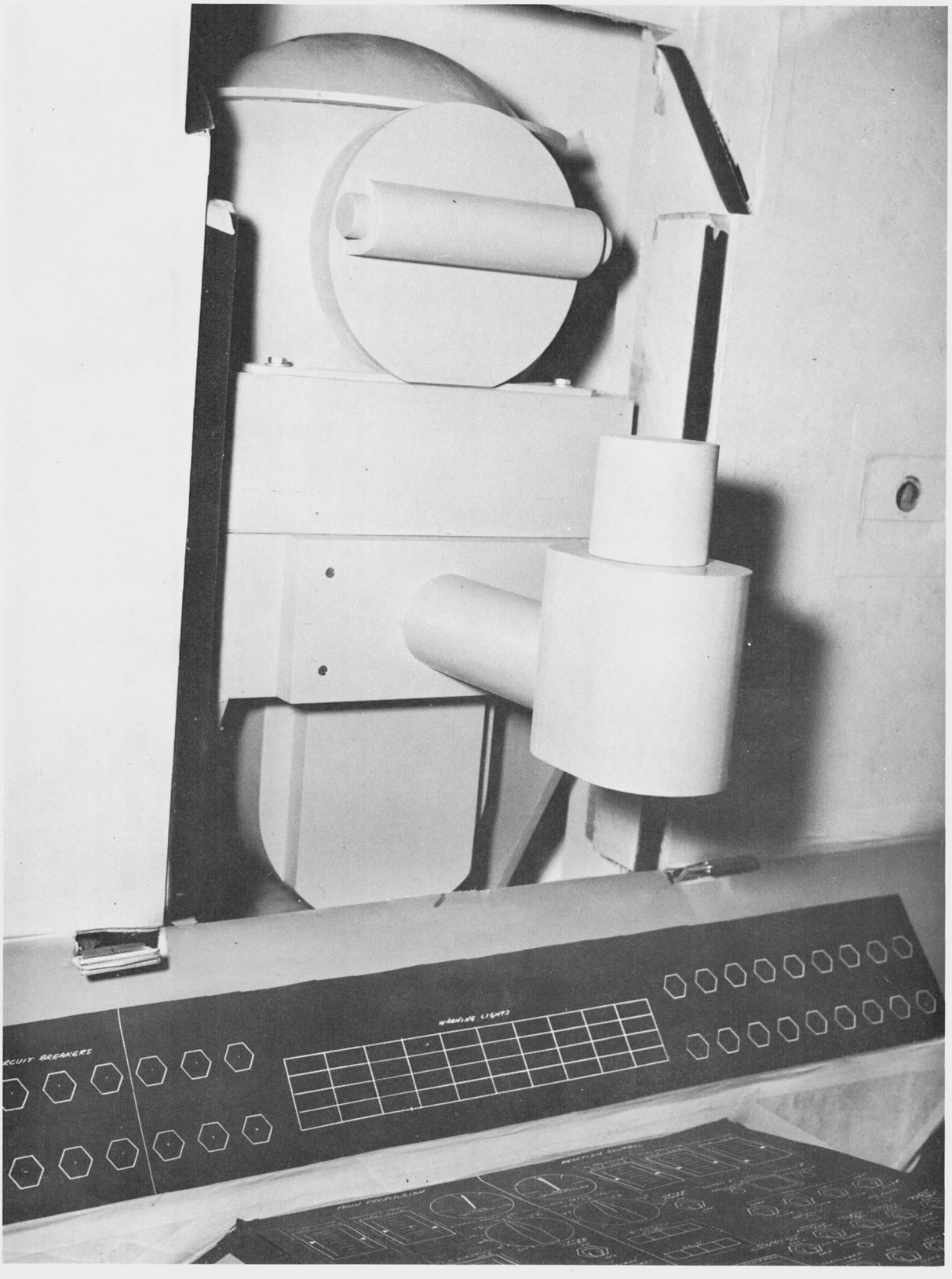


LPH-340-171 View Showing Equipment Tunnel - Upper Hatch Closed

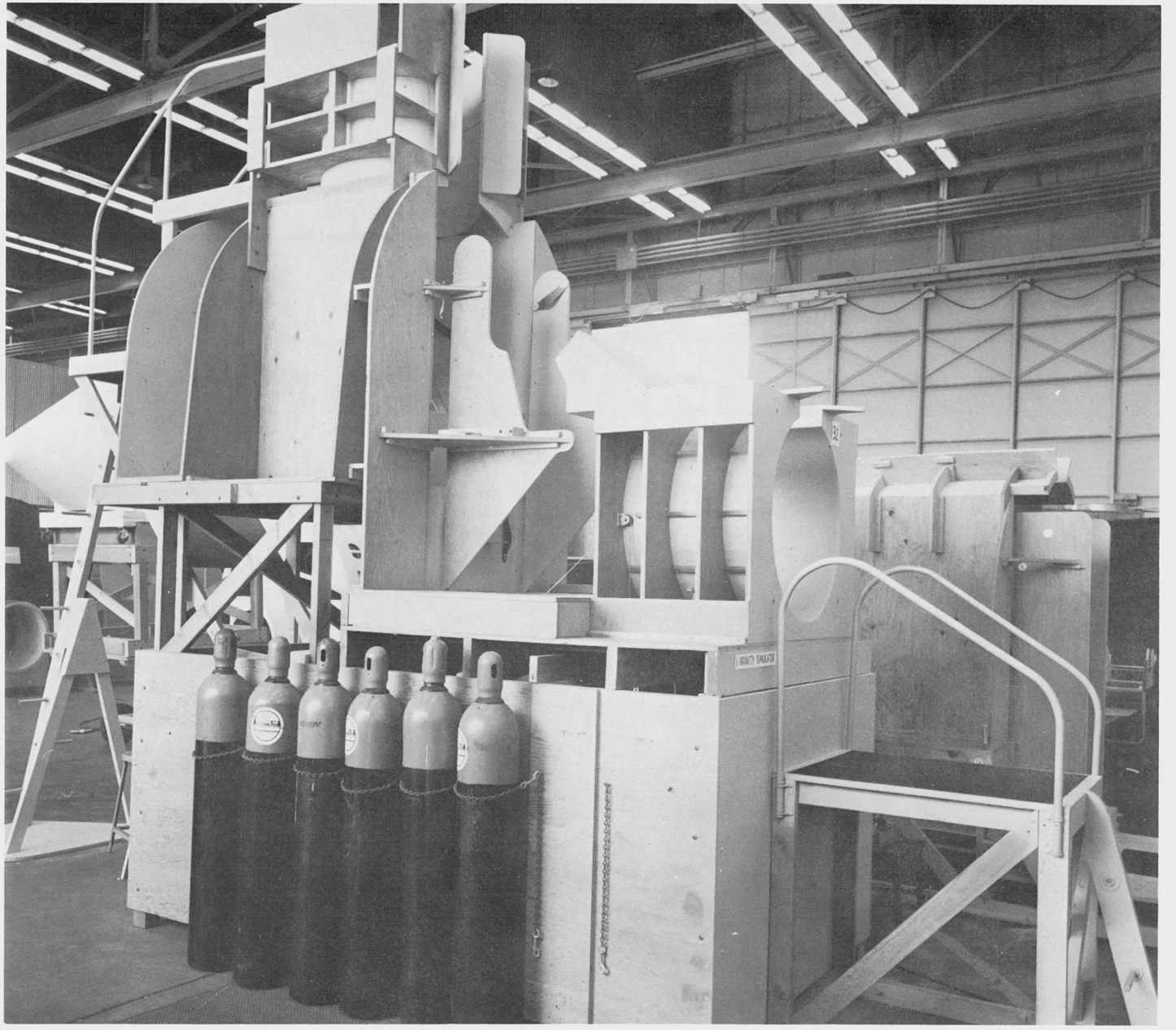


LPH-340-172 View Showing Equipment Tunnel - Upper Hatch Opened

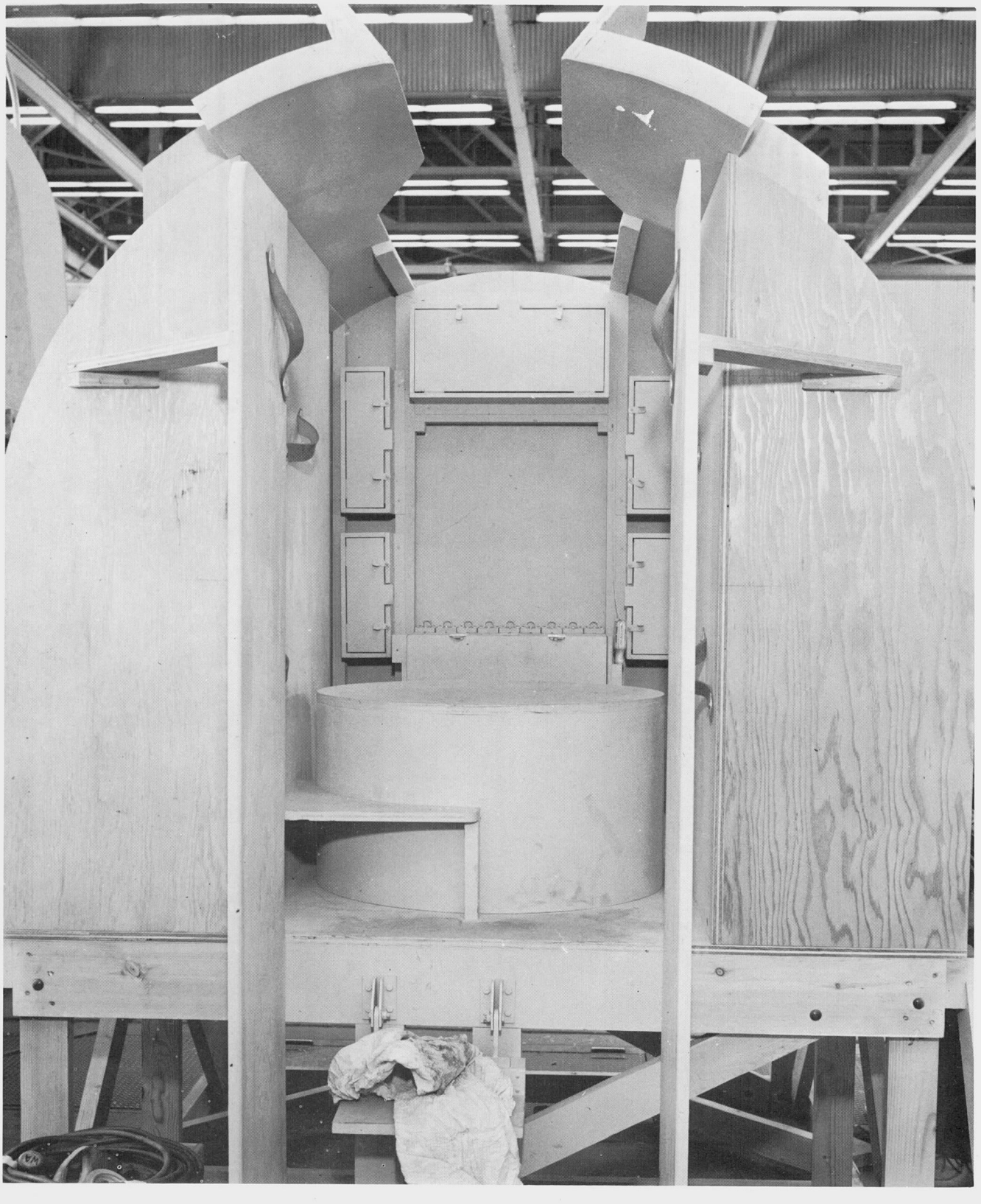
LPH-340-174 View Showing Lunar Surface as Viewed From 1000 ft. of Altitude



LPH-340-175 View Showing Installation of IMU, AOT and BGP in Overhead Section of Cockpit



LPH-340-176 View Showing 1/6th Gravity Demonstrator (Peter Pan Sr.)



LPH-340-177 View Showing 1/6th Gravity Demonstrator (Peter Pan Jr.)

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE, LONG ISLAND, NEW YORK
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(Applicable information shall be completely filled in)

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DISCUSSED WITH _____ _____
(Contractor Rep) (NASA Rep)

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REMARKS AND RECOMMENDATION

(Do not write below this line)

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CLASS I	☐	- GAEC IS DIRECTED TO COMPLY	CHANGE MOCK-UP NO ☐ YES ☐
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CLASS III	☐	- GAEC CONDUCT DETAILED REVIEW AND REPLY BY DATE SPECIFIED	ESTIMATED WT. (+)_____lbs. (-)_____lbs.
CLASS IV	☐	- RETAIN AS DESIRABLE OBJECTIVE	
CLASS V	☐	- DISAPPROVED	SIGNATURE OF BOARD CHAIRMAN

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